SCIENTIFIC AMERICAN

APRIL 5, 1913

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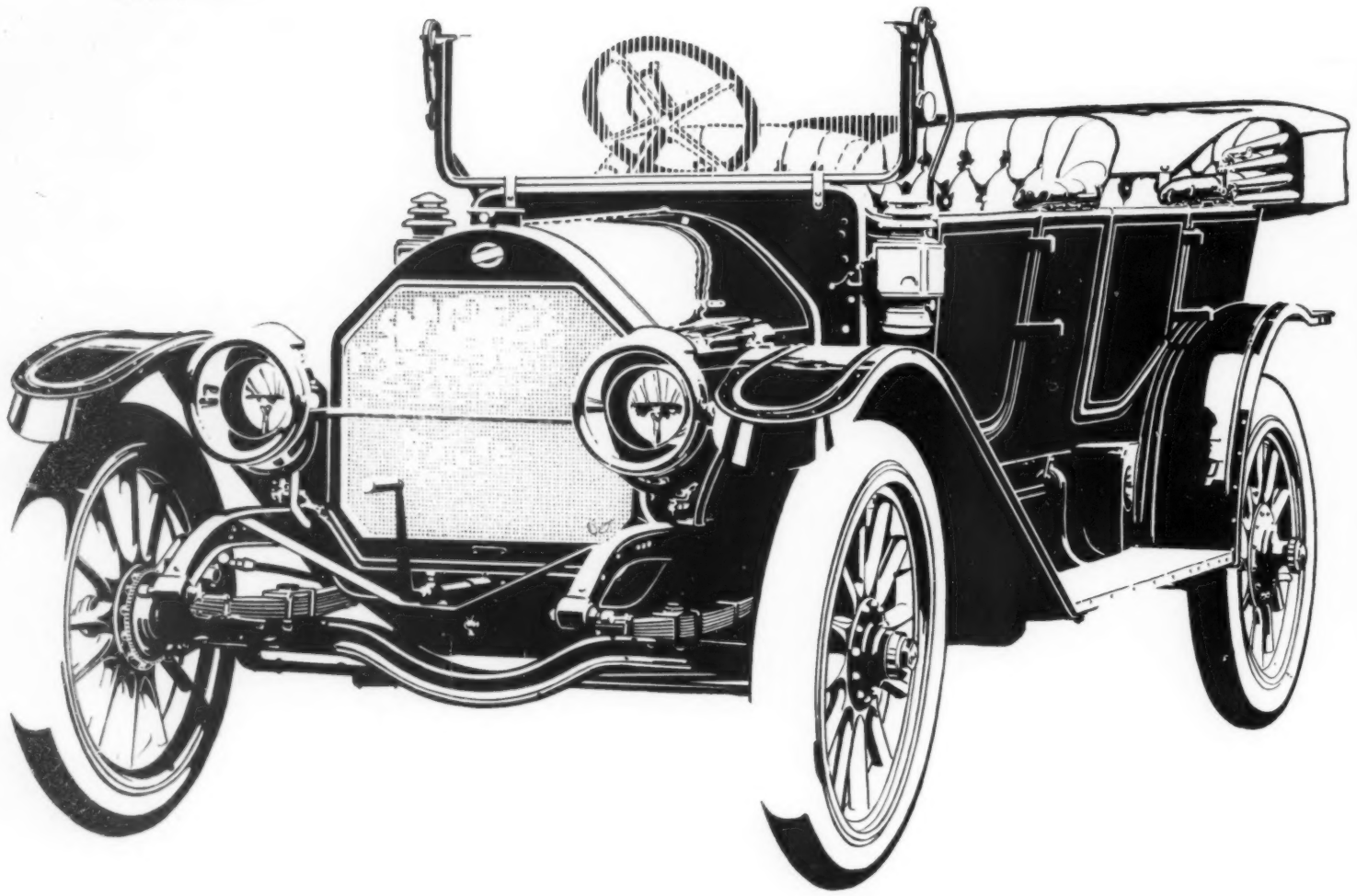
From a Painting by J. C. Chase.

Harnessing Nature.

What the Flying Machine has done in War.

Inventions, New and Interesting.

Vol. CVIII. No. 14 Munn & Co., Inc., Publishers New York, N.Y. Price 15 Cents



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DURING January and February, the dullest period in the automobile business, we were always over 5,000 cars behind our "immediate shipping orders." From this you can judge what the demand will be from now on, which is the most active automobile buying season.

See the Overland dealer in your town now. The earlier you book your order the quicker you get your car—and spring is practically here.

Literature on request. Please address Dept. 27

The Willys-Overland Company

Toledo, Ohio, U.S.A.

Five passenger Model Montclair
A high powered "Light Six" Lozier $3250

On the busiest streets in the world

just as on the great touring highways—at home and abroad—you find, in fast increasing numbers, the Lozier.

Lozier—admittedly the predominant Six—is now in its sixth successful season. These years of six-cylinder experience, and six-cylinder *supremacy*, are a guarantee of highest grade construction. You can find Lozier quality in all its phases only in a Lozier car, and most men who know automobiles *best* are not *satisfied* with *less*.

With two great models—the famous Big Six and the new Light Six, "a self-seller"—Lozier achieves sensational success this year. Our ambition is to be able to build *enough* Loziers to meet the Lozier demand.

"LIGHT SIX" $3250

AUTOMOBILE authorities, writers in technical journals, owners of high-grade cars, and the trade, all declare the *one* surprise and feature of the year has been the production of a Lozier—and a *true* Lozier—at a medium price.

When we announced this lighter model of the only American-built car which for eight years has commanded and still commands a price of $5,000 that announcement instantly became the talk of the industry.

But it remained for *the car itself* to create the real wonderment. Here, truly, was a *Lozier* for only $3250. A Lozier in every line and every part—not quite so large as that marvelous *big* Lozier which for years had commanded the respect of the public and the industry alike, but high powered—and a Lozier through and through, a Lozier in its strength and safety and comfort and finesse of workmanship and distinctive beauty.

Our dealers, themselves, named the LIGHT SIX "a self-seller." And the three months past have proved that it *is*. The demand for this Lozier at *less than $5000* is a *factory capacity demand*.

You will marvel at the *completeness* of this car. A more perfectly equipped car has never been produced. Everything you could *ask* for is on the car. Electric self-starter—electric lighting—Warner speedometer—windshield *built into body*, adjustable for ventilation and rain vision—silk mohair top, top cover, curtains quickly adjustable from seat—instantaneous locking tire carrier—clock—electric horn—trunk rack—everything that makes a car really *complete*. And remember, the Lozier "LIGHT SIX" has left side drive, center control, a "stream line" body and many other advanced features, without which no high grade car should deserve your serious consideration.

Lozier "Light Six" Touring Model and Roadster $3250
Coupe $3850; Limousine $4450

"BIG SIX" $5000

ALL PRESENT indications point to a record sale of Lozier Big Sixes this season. Never before have the wealthy and discriminating motor car purchasers expressed their convictions so clearly in favor of the Lozier. Their attitude is well founded.

The Lozier has *proved* itself the superior Six. Years of service in owner's hands and years of gruelling tests on every principal American speed-way have left no room for doubt of Lozier efficiency.

And, added to the proof of Lozier six-cylinder supremacy, new advanced features of construction make the big Lozier stand out in the foreground of all high-grade cars.

The new automatic-level oiling system gives high oil level at high speeds, low level at low speeds, a smokeless exhaust at all speeds, an efficiency beyond all previous achievement.

The motor is the most powerful ever built into a Lozier car, but vibrationless and silent with the widest known range of speed.

Triple ignition provides a medium for securing *tremendously* increased power *when you want it*.

Left-side drive and convenient center control, as featured in the Lozier, are rapidly becoming standard construction on all automobiles.

Fifty-eight sets of ball-bearings—more than used in any other car in the world—explains, in part, the unequalled Lozier power, mastery of the longest and steepest hills, Lozier motor flexibility and Lozier long-life.

Touring Models and Roadster $5000
Limousines and Landaulets $6500

Among the prosperous manufacturers of low-priced cars and among the heads of the great accessory manufacturing concerns—men who really are in position to judge automobile values accurately and men who, for their own uses, want to drive the best—Lozier is the distinct favorite. Eight executive heads of one low-price car company, alone, have purchased and drive Loziers. THESE MEN KNOW.

LOZIER MOTOR COMPANY, 4504 Mack Avenue, DETROIT, MICH.

Factory Branches in New York, Chicago, Philadelphia, Boston and San Francisco. Dealers in all principal cities

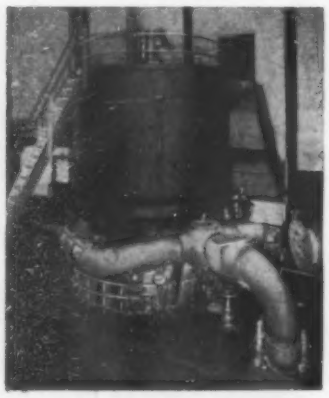
Harnessing Nature–Electrically

Human ingenuity, assisted by the ability of large manufacturing companies to produce practical and economical machines, is conquering the powers of nature more completely every year.

The product of the coal mines is transformed into electric power in all parts of the country by large steam turbines built by the General Electric Company, gasolene is used economically in isolated localities by the G-E gasolene electric generator, and the G-E Gas Electric Motor car is giving excellent service on rural steam lines.

Enormous generators connected to water turbines are successfully harnessing the water powers and pouring cheap electric power into the large transmission distribution systems which make possible the present wide use of electricity.

The future may see nature harnessed in new ways—from the sun, wind, or sea—who knows? But one thing is generally accepted: that new methods will be combined in some way with electricity—for the increasing economies of transmission, the convenience of application in the factory, and the increasing use of Edison Mazda lamps in the home—all point to the continued use of electricity long after the coal resources of the country have been depleted. With this in mind it is interesting to note how electricity has been harnessed by the General Electric Company's apparatus.



20,000 KW G-E Steam Turbine

Lighting the home with Edison Mazda Lamps

10,000 HP G-E Water Wheel Generator

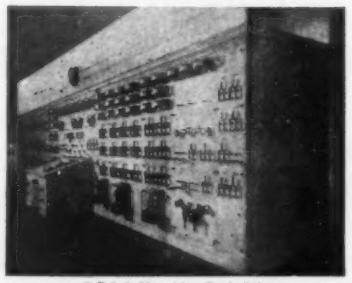
G-E Gas Electric Motor Car

The Controlling Reins of Nature's Harness

In steam turbine and water wheel stations the control is so perfect that one man can sit at a desk or bench,—in front of a switchboard at a distance from the machinery, and by means of small levers can start, stop, or regulate the power at will. This power transmitted to cities and towns is again controlled by smaller switchboards, which distribute the current in factories, railways, or homes as required.

Small Switchboard built by General Electric Company

In the modern factory today men no longer have to pull levers, or shift belts, for the G-E push button method of control enables the operator to start the motor by simply pressing the button, thereby giving him more time and energy for his work. By simply pushing a button also the engineer in the basement of a modern city building can regulate the speed of the ventilating fan on the top floor or turn on the electric sign on the roof.



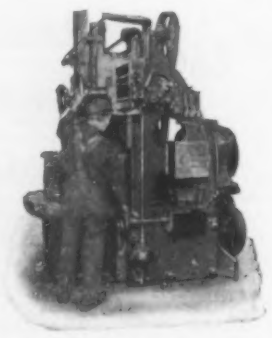
G-E Switchboard in office building

The large electric motors for the Panama canal locks will be operated from a distance by small G-E control switches. Many large enterprises such as the Catskill Aqueduct, employ automatic devices to keep water levels constant without attention.

In railway service, the General Electric Company's platform type of control is well known. For heavy train service Sprague G-E type M control provides for the addition or dropping of cars; for automatic acceleration when required; and for the stopping of the train automatically when, for any reason; the motorman's hand leaves the handle which controls the train.

In the home, a press on the button, turns the power of electricity into light, heat or power by means of devices which are becoming universal throughout the country.

The extensive resources and manufacturing facilities of the General Electric Company have assisted in the work of harnessing nature in the manner briefly outlined above.



Machine Shop Motor operated by G-E hand control

Wood Working Machine operated by G-E push button control

As new circumstances arise, these same facilities will be devoted as heretofore to the development of practical and reliable apparatus for the harnessing of nature-electrically in the service of man.

Complete information on any of the equipments mentioned above, or on any problem of controlling electric power, will be furnished on request from our nearest office.

General Electric Company

Largest Electrical Manufacturer in the World
General Office: Schenectady, N.Y.

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SIXTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CVIII. NUMBER 14.

NEW YORK, APRIL 5, 1913

[15 CENTS A COPY $3.00 A YEAR

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The Sacred Heart Convent in Omaha after the tornado passed.

Copyright, 1913, by Newspaper Enterprise Association.

Scene in a thickly populated Omaha district.

THE HAVOC WROUGHT BY THE GREAT STORM IN OMAHA.—[See page 315.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, APRIL 5, 1913

Published by Munn & Co., Incorporated. Charles Allen Munn, President
Frederick Converse Beach, Secretary and Treasurer
all at 361 Broadway, New York

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Subscription one year $5.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 6.50
Subscriptions for Canada, one year, postage prepaid, ... 5.75

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Harnessing Nature?

AS WE go to press with an issue of the SCIENTIFIC AMERICAN devoted to the subject "harnessing nature," the country is being overwhelmed by telegraphic reports of appalling losses of life and property, which prove how limited, after all, is our boasted control of the primal forces of nature—should they make a sudden and more than average display of their latent powers.

Broadly speaking, the history of the human race may be defined as a story of the ceaseless struggle of man to control the natural forces by which he is surrounded and turn them to useful account by making them the ministers of his comfort, profit and pleasure. In the earlier ages of history, these agencies were regarded as hostile and hurtful; and superstition readily clothed the winds and waves, the mighty rivers, the storm cloud and the rain storm with ideas of sinister and cruel malevolence. It took the growth of knowledge, the accumulation of experience, and the exploration of the thoughtful mind reasoning from this to that, to gradually open the eyes of man to the fact that the forces of nature, when judiciously cajoled and brought into subjection, might be transformed from supposed avenging deities into helpful servants, the limit of whose contributions to man's happiness and prosperity was measured only by the degree of his intelligence, industry and opportunity.

In spite of the very impressive record made by some of the ancient races—the peoples of Babylonia, Egypt and, later, of Greece and Rome—it must be admitted that the actual conquest of nature—or "harnessing of nature" if the term be preferred—has occurred in the nineteenth and twentieth centuries, the age of steam and steel and electricity. Our giant steamships drive their way—the biggest of them—across the oceans, quite regardless of the stress of wind and weather. Our railroad trains speed on their appointed schedules across plain and valley, over mighty water courses, and through the very heart of the mountains, carrying their priceless freight of millions of people and tens of millions of products, with a regularity that fails to astonish only because it is so thoroughly familiar. We live, or do business, in towerlike buildings, which we have raised, daringly, nigh upon a thousand feet into the heavens, where the towering fabric meets the buffeting of the hurricane, not only secure, but practically without a tremor from flagstaff base to foundation. We have shut the once devastating floods securely within their mountain recesses; and we let them run down to the thirsty plains when we choose, and in just such volume as we will. We have joined in wedlock the devastating powers of the floods with the once terrifying fire and might of the thunder cloud, and out of this union have been born those wonderful hydro-electric works which are furnishing light, power and heat to the millions of our towns and cities.

We boast that we have thus harnessed nature to our uses. Yet it is true, and the thoughtful among us well understand that nature has become our beast of burden, not by compulsion, but rather by cheerful submission. Now and again she bestirs herself, and, as if to put us in mind of the fact that, if she will, she is master, not servant—in some hour of ugly temper, she smites us with the full force of her hidden potentialities. Let her activities become only a certain per cent greater than their normal, and disaster, often terrible disaster, sweeps over the very people whom she seemed so faithfully and submissively to serve. Nature has but to turn herself over, in her long geological sleep, for a little easier adjustment, and a San Francisco is thrown down in widespread ruin. Over night, the rains which fill our power producing reservoirs and give the necessary depth for commerce to our rivers, have but to shed something more than their usual supply of moisture, and by the morning cities and villages are overwhelmed by the score, the loss of life is numbered by the thousand, and the destruction of property by millions in dollars.

Judged from the standpoint of science and engineering, although there is much to make us feel extremely discouraged, there is nothing in the recent disasters to make us despair. When these terrific floods have been thoroughly investigated and the causes of the failure to hold them in leash have been ascertained, we shall have learned how to safeguard by better methods of control and more secure construction against a repetition of such a wholesale flooding of fruitful lands and populous cities. Indeed, it is likely that some day in the far future, and sooner than most of us are just now able to believe, we shall find out how adequately to control the rivers and keep them within their banks, and build reservoirs of such capacity and stability as will hold back the flood waters until the menace has passed by.

In the presence of such a tornado as has recently swept through the Middle West, we must confess to a feeling of absolute helplessness. Much can be done, it is true, in the way of special construction to mitigate the devastation of a tornado; though it is questionable if even building massively in stone and concrete would suffice in the presence of such an appalling fury as recently swept over the ill-fated city of Omaha.

The Society for Electrical Development

WHATEVER may have been the sins of the gigantic trust, even its enemies were willing to admit that it was usually efficient, largely because its administration was centralized. But a single department purchased the cargoes and trainloads of raw material which it converted into manufactured products; a single advertising staff prepared its selling announcements and bought space in magazines; a single board of directors guided its commercial destinies; in a word, harmony and co-operation were substituted for discord and strife.

Now that the Government has decided through its courts that many combinations of manufacturing enterprises, however economical and efficient they may be, are detrimental to the best interests of the country, how is it possible to apply the lessons taught by the trust without incurring the displeasure of the Attorney General of the United States? An answer is to be found in the Society for Electrical Development, formed for the sole purpose of introducing electricity more widely and of eliminating the useless friction which has marked the development of the central station industry in this country. Although electrical goods and electrical energy to the value of two billion dollars a year are sold in this country, the market for electricity has only been skirted and never really penetrated. There have been conflicting interests and conflicting policies, with the result that of all marketable commodities—and electrical energy is as much a commodity as oil or sugar—electricity is not sold on an efficient and businesslike basis.

All this the Society for Electrical Development intends to change. Central stations, architects, contractors, electrical manufacturers, the host of industries dealing in electricity or dependent upon electrical energy, are to unite in popularizing electrical service. There are about ten million buildings in this country in which electricity could be used to profit. Yet only one in five is wired for service. If the public can be taught that electricity is not a luxury, if the central stations can be brought to the view that the small consumer's business in the aggregate is as lucrative and even more so than that of the occasional large consumer, if the thousand and one interests that have been warring in the past can join forces in the effort to expand the electrical business of this country, we may indeed look forward to that "electrical age," which has existed hitherto only in the pages of the sensational newspaper.

Fortunately the men responsible for the creation of the Society for Electrical Development have long been identified with the electrical industry in this country. Mr. Henry L. Doherty is the president. Associated with him are Mr. Wakeman and Mr. Philip S. Dodd, both thoroughly familiar with the business needs of central stations and manufacturers of electrical goods. Thus competently guided, the enterprise should infuse a new spirit of co-operation into the business of selling electricity and electrical goods. If it succeeds, as it gives every promise of doing, the experiment will probably be repeated in other industries; for it will mean the retention of the trust's efficiency in selling, without any attempt to control the market.

Small Internal Combustion Engines on Land and Water

IN SEVERAL ways, the designers of motor car engines would seem to be lagging behind their nautical brothers, and the increasing use of kerosene fuel in small marine engines indicates one very important step forward that is not shared alike by both. So far, very little indeed has been done by the automobile engineer in solving this difficult problem, whereas the number of marine internal combustion motors utilizing the cheaper fuel is steadily increasing. As a matter of cold fact, the manner in which manufacturers of such engines have turned to kerosene as a solution of the fuel problem and the great number of them that have succeeded in employing it instead of gasoline (with gratifying results, be it added) constitutes one of the real features of the year.

Manifestly, it is no easy matter to convert an engine constructed for gasoline consumption, to operate on kerosene, or on some of the still heavier distillates, as not a few of them do. Merely altering the carbureter and providing means for applying heat to assist vaporization will not suffice, for, although almost any gasoline engine can be made to run on kerosene after it has become sufficiently heated, it cannot be made to run efficiently on the heavier fuel. Efficient operation requires other and more extensive alterations which virtually necessitate a complete re-casting of designs. Up to the present time, marine engine manufacturers have done very well, considering the comparatively short space of time that has been seriously devoted to experiment. That there still remains room for improvement is evident in the universal necessity for employing gasoline as an alternative for the inevitable heat, for starting purposes. In other words, the kerosene engine that will start "all cold" on kerosene, as infallibly as will the gasoline engine on gasoline, has yet to be evolved. But problems apparently more hopeless than this have been solved in the past.

But though the makers of small marine engines undoubtedly are ahead of their landsman brothers in the use of kerosene, they are behind them in several other matters, prominent among which is the inclosure of such parts as the valve mechanism. Marine engines of the high-speed type are steadily becoming more like the typical automobile motor, as witness the marked tendency toward the block construction of cylinders and the extension of crankcases to include the clutch and reverse gear, thus making of the whole power plant virtually a single unit. Despite this fact, however, designers apparently have overlooked the desirability of inclosing the valve parts, as it is done almost without single exception in automobile motors.

The accomplishment is simple in itself, requiring as it does merely the addition of a couple of light metallic plates, and its advantages in reducing noise and decreasing wear by excluding dirt and permitting more plentiful lubrication must more than offset the low initial cost. On the score of decreased noise alone, the addition of such protection plates would appeal, for as every one knows, the valve mechanism is the hardest of all to silence, and there are few things more abhorred by the average motor boatist than the incessant clicking and hammering of the valve tappets.

Thanks to the ingenuity of the makers of such apparatus, high tension magneto ignition is used to a much greater extent now than it has been used in the past, which fact also marks favorable imitation of the automobile motor. The undoubted simplicity of the high tension magneto, as compared with the complexity inherent to the batteries and coils and timers of other systems, has led to the practical elimination of its one previous fault—its susceptibility to the influence of moisture. And now that this difficulty has been overcome, the increasing use of such instruments presages their still more widespread adoption in the not far distant future.

Thus, though the makers of small marine internal combustion motors have made notable strides in the past twelvemonth there is still apparent an apathy toward the engine starting devices which have become so popular for automobile work, and this despite the fact that almost invariably the marine motor is much more difficult to start than is the automobile motor. Obviously, the lower temperature at which it operates normally, and the greater dimensions of the cylinders as a rule are responsible for the greater effort required to "turn it over." That the tendency toward the use of engine starters exists, however, is made plain by their adoption by several prominent manufacturers. And it is not too much to expect that ere another year has passed, marine engine builders will have turned quite readily to such labor-saving safety devices.

Electricity

Energy Consumption in Electric Weldings.—In a discussion in a recent paper on "Resistance Welding" the remarkably small amount of energy required to weld iron wire was brought out. A weld between a pair of 5/32-inch rods takes 20 watt-minutes, which means that 3,000 welds of this kind could be made with the expenditure of one kilowatt hour of electrical energy. However, the amount of energy rapidly increases with the diameter of the rods welded, 5/16-inch rods requiring 2,000 amperes, about nine times as much energy as rods one half that diameter. This increase is due to the increased contact area and also to the rapid cooling through the jaws holding the rods.

The Telephone Equipment of Capt. Scott's Expedition.—An English paper gives an interesting illustrated account of the telephone service that was provided to connect five stations of the British Antarctic Expedition, that is, the living quarters with the four instrument and observing stations. In order to save weight, a matter of such prime importance in the transportation of supplies by polar explorers, the line wire employed was bare hard drawn aluminium. About 75 miles of this wire was carried and the lines connecting the stations were metallic circuits of this bare wire laid about six feet apart on the dry snow which, as is well known, is an excellent insulator. The low temperature precluded the employment of individual batteries at the stations, and a 24-volt "common battery" was used.

Working Cables and Land Line Without Re-transmission.—A new and very simple system of submarine cable working, the invention of a British telegraph engineer, is announced. By reversing the current for each successive signal, the distinctness of the signals is so increased that the siphon recorder, hitherto the receiving instrument *par excellence* for cable working, bids fair to be eliminated. By the new system two successive dots, for example, are signaled by two currents of opposite polarity. It is stated that the ordinary Morse code can be used, and a land line can be joined up with a cable and a message sent by an ordinary telegraph key. Although it does not appear that the speed of signaling is increased by the new method, the elimination of re-transmission at the junctions of land lines with cables (under certain conditions which will doubtless appear when the invention has been tried out) is in itself an important improvement in telegraph engineering.

A New Electric Tanning Process, invented by the Swedish scientist Dr. A. Groth and applied on a practical scale in an English works, is attracting much attention, and it is stated that one of the prominent electrical firms is soon to take it up for commercial use. With this method, the hides are put in special vats along with metal conductors, so as to carry out an electrolytic action, and this will tan the hides in much less time than usual, for instance, six weeks as compared to several months. Leather of better quality is produced in this way, and the method gives a perfect and solid tanning. The details of the method are not as yet made public. Various electrical devices in the shape of regulators and indicators, also safety apparatus for over-current, make the process almost an automatic one, and in the present trial plant at Kidderminster two persons are all that is needed to take care of the whole. Should anything go wrong in one of the vats, electric bell or lamp signals give warning at once. The plant keeps running day and night.

Remote Control of Light and Power Circuits.—Turning on and off the electric lights connected to a distant service circuit has been a problem that has hitherto been met in three ways; by sending a man to manually switch on the lights in the evening and switch them off again in the morning, by clockwork switching devices set to operate at a pre-determined hour, and by utilizing a prepayment meter to open the circuit when a determined amount of energy shall have been consumed. A new method of remote control of lighting and power circuits, whereby such circuits may be closed at any time from the central station (as for example to cover the contingency of a sudden fog, and varying hours of darkness) has been devised, utilizing a special current superposed on the main lighting current whether the latter is alternating or direct. The new system is particularly adapted to the control of street lighting circuits. In the application of this method to alternating current service a "ripple" or alternating current of higher frequency than the actual frequency of the service current is sent out over the mains for an instant, actuating a local switch-operating relay permanently connected to the mains but designed to be sensitive only to the "ripple" frequency. In the application to direct current service a condenser included in the relay circuit acts to prevent consumption of energy in the relay except during the moment of passage of the alternating current ripple which traverses the condenser in operating the relay.

Science

Captain Scott's Journal.—According to the London *Times*, Lady Scott has telegraphed from New Zealand that her husband's journal is in her possession, "excellent and complete." The whole will be published shortly in book form, and parts will appear in an English magazine.

Peary at the International Geographical Congress.—Rear Admiral Robert E. Peary recently sailed for Naples, on his way to Rome, where he is to attend the Tenth International Geographical Congress, which opens on April 10th, and the meeting of the International Polar Commission which will follow it. Rear-Admiral Peary will represent the United States officially.

The Philatelic Library of the late Lord Crawford, the most comprehensive collection of books and pamphlets on postage-stamp collecting that has ever been brought together, or is ever likely to be, has become, by his bequest, the property of the British nation, and will doubtless be placed in the British Museum. Mr. Bacon's catalogue of it, recently published, is a large quarto volume of over 450 double-column pages, and its compilation extended over several years.

The Brilliancy of Venus in the evening sky during the early months of this year has led to the usual crop of wild rumors as to what the "strange light" could be. In England it has been mistaken for a German military airship; while the newspapers of southwestern Russia have been reporting nightly visits from an Austrian spy in an aeroplane. It may be recalled that, many years ago, a section of the New York public took the same planet to be an illuminated balloon sent up by Mr. Edison from Menlo Park in the course of some mysterious experiments.

The Term "Gouffre" is applied in Haiti to mysterious acoustic phenomena, probably of subterranean origin, and evidently belonging to the class of sounds known as "brontidi" or "brontides" (see SCIENTIFIC AMERICAN, January 18, 1913, p. 66) reported from various parts of the world. They seem, however, to be much more varied in character than the typical brontides of Italy, Belgium, etc. Sometimes they resemble the boom of cannon, but again are described as deep rumblings, howlings, a rushing sound, as of wind, a deafening crash, "as if a mountain of glass were shattered," and so on. They have been known in Haiti from the times of Moreau de St. Méry and the other early historians of the country. St. Martial Observatory, at Port au Prince, has undertaken a systematic investigation of this phenomenon by means of a *questionnaire* addressed to numerous residents of the island, thus following the example of Van den Broeck in Belgium, and Alippi in Italy.

The Failure of the "Electric Niagaras," or overgrown lightning-rods, recently erected in several parts of France in the belief that they would avert hailstorms "by drawing the electricity from the clouds," is reported in emphatic terms by a writer in the *Journal* of the National Society of Horticulture of France, M. A. Laforest (who, however, advocates the equally illusory expedient of "hail-shooting!"). Several severe hailstorms occurred in Paris shortly after a great "Niagara" had been installed on the Eiffel Tower. (See SCIENTIFIC AMERICAN, June 29th, 1912, p. 548.) On June 19th, 1912, hail fell in great quantities at the very foot of the tower and over an extensive area adjoining. The use of these devices began some eleven years ago in the department of Vienne, and it has been repeatedly claimed that they have completely exempted that part of France from hailstorms ever since they were installed. This claim was, however, investigated by M. Turpain, in 1911, and found to be without foundation. Fifty-two "Niagaras" had been erected in various parts of France up to last October.

Scientific Results of the War in the Balkans.—In the *Bulletin of the American Geographical Society* Leon Dominian calls attention to the rich field of investigation that will be opened up by the passing out of Ottoman control of a large section of the Balkan peninsula. Nearly every square mile of the territory in question needs mapping, and it is besides a practically virgin field for geological, ethnological and historical research. To judge from the cartographical work heretofore done in Bulgaria by the Military Cartographical Institute, at Sofia, we may expect excellent map-work in whatever territory that country may acquire from Turkey. Whatever may be the merits of the quarrel between Turkey and the allies, it is notorious that science and exploration do not flourish under the Crescent, whereas the other Balkan states are at least in sympathy with modern ideals in these fields, so that the outcome of the war, up to date, is fortunate from a scientific standpoint. Just to mention one point of contrast: Bulgaria, Servia and Greece all possess official meteorological services, with networks of stations whose observations furnish the material for compiling climatic statistics of those countries. Turkey has nothing of the sort, and what little information we have of her climate has not been gathered by Turks.

Aeronautics

The International Commission for Scientific Aeronautics (which ought to be called the International Aerological Commission) will hold its next triennial meeting in London, in 1915.

Bomb for Use with Aeroplanes.—Hiram Stevens Maxim, of London, England, assignor to Vickers, Ltd., Westminster, England, has secured a patent, No. 1,052,606, for a bomb for use with flying machines, which bomb has a charge of high explosive, a detonating charge and a pole which is adapted to move relatively to the bomb when the latter is liberated and to bring the detonating charge into position to fire the main charge when the extremity of the pole strikes the ground, an object or a target.

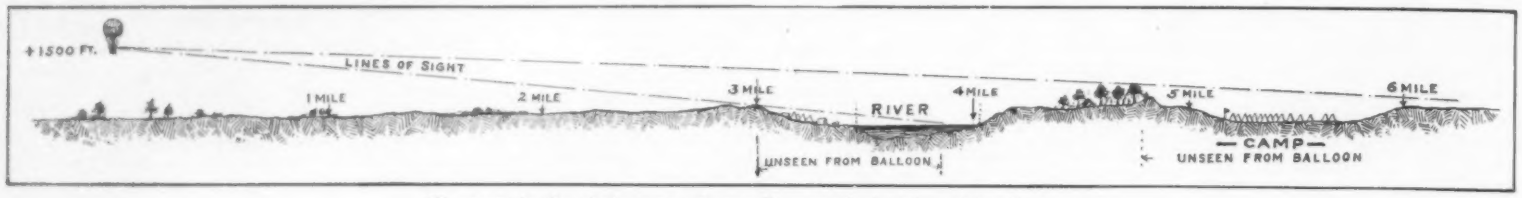
Aerological Station in the Heart of Africa.—The German government, which has already done so much more than any other government in the world for upper-air research, is now planning a permanent aerological station on Victoria Nyanza. It was over this lake, in the year 1908, that a German expedition sent up the first sounding-balloon that ever reached the isothermal layer in equatorial regions, and observed, at an altitude of 12 miles, the lowest temperature ever recorded in the atmosphere, viz., 119 degrees below zero Fahrenheit.

An Erroneous "Record" in Ballooning.—In August, 1909, much interest was aroused by the statement published in the London *Times* that two Italian aeronauts, Lieut. Mina and Signor Piacenza, had ascended from Turin in the balloon "Albatross" to an altitude of 38,715 feet, exceeding by more than 3,000 feet the altitude attained in the famous ascent of Assman and Süring, in 1901, which was a world's record. According to a note published in *Nature* this story was something very like a *canard*, as the aeronauts had no proper means of measuring their height, and have since published a revised estimate reducing the reported altitude to 30,300 feet.

Aeronautical Surveys.—The idea of carrying out surveys in the Sahara and elsewhere with the aid of airships and aeroplanes has often been suggested, and it seems likely that many blanks on our maps, where ordinary surveying methods are difficult or impossible, will ultimately be filled up in this manner. A German writer calls attention to the fact that the first demonstration of the feasibility of such undertakings was furnished by the Italian military aeronauts during the recent war with Turkey. A large tract of country around the city of Tripoli was mapped from overhead. The data thus obtained enabled the general staff to construct a series of charts on a scale of 1:40,000.

Strain on Monoplane Wings.—In a recent number of *Flight* Mr. Griffith Brewer takes up the subject of the collapse of monoplane wings. Calling attention to the fact that about a year ago Blériot reported to the French government that monoplanes were liable to collapse in the air, not only by the breaking of the stays under the wings, but also by the breaking of the supports over the wings, Mr. Brewer inquires into the cause of the structural collapse to which monoplanes seem to be peculiarly liable. Because the wings of monoplanes project like arms from the sides of the frame, he agrees that it is easier to twist the outer ends of the wings than the shoulder portions. "Without changing the path of flight of the machine," Mr. Brewer states, "the speed of travel may increase, and this causes the center of pressure to travel backward, thus tending to turn the wings over forward, owing to the pressure below the front portion decreasing while the pressure increases below the rear portion. The effect of this change in the center of pressure is a progressive twist from the shoulders of the wings outward, the left wing twisting like a right hand corkscrew and the right wing twisting like a left hand corkscrew."

Aeroplane Trips Between Nice and Monte Carlo.—The Trans-aerian company is organizing a daily service of aeroplane trips over sea between Nice and Monte Carlo on the Mediterranean coast. Hydro-aeroplanes are to be used, and they will fly along at a short distance off shore during the trip. For greater safety, a motor launch will accompany the flyer, although it is now recognized that there is little danger in an over-water trip on a hydro-aeroplane. This appears to be the first instance of the regular use of the hydro-aeroplane, and the results will be watched with interest. The trip from Nice to Monte Carlo costs $50 and the round trip $60. A ten-minute flight near the well known Promenade at Nice will cost $40 additional, with the same rate for a flight over the bay at Monte Carlo. The company has already installed a station at this latter port, and the hangars are located at Monaco on the south quay, along with a slip for putting the aeroplanes afloat. Passengers can thus be easily taken on board. At Nice, a motor launch takes passengers from the Promenade to the embarking point. During the trip, the flyers will alight at the midway point of Beaulieu where a special wharf of iron construction is put up, and a motor boat takes the passengers from here to the landing place of the aeroplane, or the reverse. Astra hydro-aeroplanes will be used.



The scout in the air does not always discover the location of hostile troops.

Achievements of Military Aircraft

Lessons Taught by the European Maneuvers and by the Tripolitan and Balkan Campaigns

By Major H. Bannerman-Phillips

LET us consider in a general way the advantages and disadvantages inherent in aerial, as distinct from ordinary reconnaissance on the ground. To begin with, the observer's power of traveling freely in any direction, weather permitting, regardless of terrestrial obstacles, and of placing himself directly above any object so that his line of sight is at right angles with the earth's surface, gives him a considerable advantage. The enemy's dispositions would seem at first sight to be inevitably laid bare to him, and this is true, though with certain reservations. The observer, in order to be safe from the fire of troops on the ground, must remain at a fairly high altitude and, if in an aeroplane, must travel very swiftly. Therefore his line of observation passes through a number of layers of the atmosphere, the state of which affects the possibilities of reconnaissance. Hence his view of terrestrial objects is liable at times to be blurred and indistinct. Secondly, the enemy will be on the lookout for him and in the daytime he can hardly hope to escape observation himself, and if he is covered by clouds from view of the enemy, the objects he is reconnoitering will also be hidden from him. Now, for purposes of military reconnaissance exactitude of observation is essential; therefore, the scout must have a good view. Yet while under certain weather conditions a man may be able to find his way about a country and recognize his whereabouts, he may not be able to make exact observations of the enemy's dispositions and may send in incorrect information. In any case the aerial observer requires special training and aptitude, more so than a scout at the ground level.

The Difficulties of Reconnoitering in the Air.

In observing the dispositions of troops in the field, under normal conditions of the atmosphere and from such a height as to be reasonably (though not completely) safe from terrestrial marksmen, say 3,000 feet, the radius of observation from moving aircraft may extend to four or five miles from a point vertically below the observer. Beyond this height it becomes difficult to distinguish various objects on the ground surface. Troops on the march can be seen and their numbers estimated from the road-space occupied, and the size of camps and their arrangements can be noted. Artillery in action are an easily distinguishable mark, and so are cavalry on the move and transport columns of all kinds. Massed infantry in the open are fairly distinctly seen, and peculiarities of uniform may help the observer, but infantry in khaki are difficult to distinguish when in extended order, advancing or retiring through stubble or ploughed land, and not always clearly seen on grass. Infantry columns halted during a march and sitting or lying down at either side of a road are not easily made out. In order to get any idea of trenches, outpost arrangements, and the methods of occupation of bridges and fords, the observer will have to descend within the danger zone of fire. Further, it is a common error to suppose that "everything is clearly visible" from aircraft in mid-air. For instance, at 1,500 feet up, one cannot get a view into the bottom of a valley the direction of which crosses the line of sight at a distance of say three miles if the slope down to the valley is steeper than 6 degrees. Motionless troops are hard to see even on flat ground, and the amount of concealment afforded by trees to troops underneath them (or where the trees are lofty, and come between them and the aerial observer, for some considerable distance behind them) is far greater than would be supposed. Movement will often betray the presence of any enemy who would have escaped notice if he had remained motionless, and, as often happened during the Boer war, clouds of dust will betray the movements of troops, especially horsemen, at very long distances. In clear weather, bodies of men, such as single squadrons, battalions and batteries, can be seen, when closed up, at seven to eight miles with ordinary binoculars. Field-works, if their color and outline do not blend with the surrounding features of the country, may be seen at four or five miles, but are not readily distinguishable. To tell "dummy" trenches from real ones is difficult, sometimes impossible. Railways which run parallel to the line of vision are readily made out, embankments and cuttings being especially visible, but a railway running at right angles is not always seen unless attention is directed to it by a train in movement or the smoke and steam of a locomotive. Rivers, canals, and water in the form of ponds and lakes stand out clearly, and so do bridges, but from considerable heights the smaller details of a landscape are very difficult to make sure of. Hop-fields in England, with the poles and wires concealed by the summer's growth of hops, have been taken for pasture land before now.

Army transport wagons at Mustapha Pasha as they appeared to the air scout.

The battlefield at Mustapha Pasha viewed from an aeroplane.

War trains at Mustapha Pasha railway station, a very busy transport center as it appeared during the war from a military flying machine.

Hiding from the Man in the Air.

The airman's greatest difficulties will come in the future when the art of concealment of the movement of troops, and their disguise by various methods, may be expected to reach a high pitch of perfection.

The British army maneuvers in East Anglia in 1912 were remarkable for the success of the reconnaissances effected from air-craft of both the gas-supported and heavier-than-air types, but there was one notorious failure which proved the exception to the rule. The Fourth (Blue) Division succeeded in performing a march from near Cambridge to Mildenhall, about sixteen miles, entirely unseen and unreported by the Red air-scouts, yet these latter were watched by the Blue troops from the ground-level, sailing overhead in various directions. If such an incident were related in the history of a campaign it would seem incredible, but it actually occurred nevertheless. This result was secured by simple expedients—so simple in fact that after the event they were dubbed "puerile" by at least one military critic, but their success in this case certainly justified their use. In the first place the troops started their march during the night and covered as much ground as possible before day-break. Secondly, during daytime they kept in small detachments and took every advantage of the shelter of the trees, and when halted.

or on being warned by whistle of the coming of an aeroplane, stood, sat or lay close under the hedge-rows at the side of the roads, or under any umbrageous cover which could be found. Thirdly, the white bands on their caps and anything noticeable about their accouterments were covered up, and guns and wagons when moving in the open were masked with straw to simulate country carts and farm wagons. Now, it was averred after the operations by many critics, that the aircraft throughout maneuvered unrestrainedly as regards aerial opposition and at altitudes so low as to bring them well within reach of the enemy's fire, thus making the whole system of reconnaissance unreal, and that the information so readily obtained would never have reached the commanders under actual service conditions, with ball cartridge in the rifles, and the guns firing shrapnel. Therefore, if with these facilities and under favorable atmospheric conditions the 12,000 men and horses of the Fourth (Blue) Division could succeed in escaping the observation of aerial observers at a most critical period of the operations and during a march of some sixteen miles, are we to draw the deduction that aircraft will be able to entirely take the place of cavalry in reconnaissance? This in fine weather; but when the morning mists are impenetrable from above and the clouds so low that air-scouts must descend to within reach of their enemies, they run a good chance of being "potted" like driven grouse by a hailstorm of lead from marksmen invisible under leafy shelter, and able to make good practice at the passing aeroplane, no longer soaring eagle-like in the "blue empyrean," but within easy rifle range, and a dead or captured scout has done bad work for his own side by allowing himself to be made non-effective, and causing the loss of his aircraft.

Removing a wrecked British biplane from Salisbury Plain.

By courtesy of the *Sphere*.

A German military Zeppelin coming to anchor.

Lessons Taught by European Maneuvers.

If we turn to the armies of the European continent we find no suggestion whatever of substituting aircraft for cavalry, although a far greater and more systematic use of the former has been made in French and German maneuvers, and by the Italians in Tripoli, than in England or America, and the criticisms of spectators with military knowledge and the reports of the umpires alike bear witness to the extended and valuable services rendered—more particularly by aviators in aeroplanes—when the conditions are favorable. In the French army the organization of aerial scouting is superb, according to some of the ablest British and German critics. A French general can reckon upon having any specified region examined by his aeroplane scouts, and the art of observation from mid-air has been reduced to a system as regular as that of cavalry reconnaissance. Yet in spite of this a general and his staff were taken by surprise by a body of the enemy's cavalry at the last maneuvers and captured; though they had aerial scouts at their disposal, they received no warning of the approach of the hostile horsemen.

A French critic of the German maneuvers in 1912, writing for the *Matin* newspaper in September, spoke in the highest terms of the organization of the German airships, and their officers have had ample experience in observation of military details. Yet during the previous year's maneuvers the Red side succeeded on one occasion in deceiving the scouts on board the Blue dirigible "M. II." (which was sailing at an altitude of 3,000 to 4,000 feet) as to the whereabouts of their main position. The weather was rather cloudy; a "dummy" position with artistically imitated field-works, possibly not very clearly distinguishable under such atmospheric conditions, drew the attention of the aerial observers, who in good faith reported it as the enemy's main position, whereupon the Blue force halted all night before it with a view to attack at dawn, according to the best "sealed-pattern" tactical methods, only to find in due course that it was a blind, and the real position had been carefully entrenched some miles away.

At the German maneuvers in September, 1912, the impossibility of relying upon aircraft alone for reconnaissance was strikingly illustrated. During the operations about Oschatz-Mügeln both armies entrenched themselves on the night of September 12th, and were facing each other at a distance of a few kilometers, anxiously awaiting dawn. At daybreak they met in battle. There was a thick mist until 9 A. M. and no information was obtainable otherwise than by cavalry; neither airships nor aeroplanes could enable the overhead observer to see anything at all, but the mounted scouts were able to get very close to the infantry unobserved. The cavalry, taking advantage of these conditions, made repeated charges against the infantry, and their performances served to remind military critics that in spite of modern inventions the sword and lance need not yet be relegated to the museum. At the conclusion of the operations the general staff, commenting thereon, laid great stress on the decisive rôle played by the cavalry, and though approving of the work done by the aircraft, pointed out that these latter by no means made cavalry reconnaissance superfluous, since for two days out of five the weather kept both dirigibles and aeroplanes on the ground.

Triumphs of the Air Scout.

That air scouts may render invaluable service in the matter of clearing up the "fog of war" goes without saying, not only by procuring information on their own account, but in verifying and confirming or disproving, with a minimum waste of time, reports which have been sent in by other means. Thus, for instance, during the German maneuvers of 1911 they saved the Red side from being deceived by a bogus map, dropped by the Blues, and a dummy position in connection therewith. During the operations about the Tchataldja lines in 1912 in the Turko-Balkan campaign it is said that on one occasion Derkos was reported to have fallen into the hands of the Bulgarians, but an aviator who was sent up to find out about this returned within the hour with an assurance to the contrary.

During the Italian campaign in Tripoli the frequency and regularity of the aviators' ascents and the freedom from mishaps were outstanding features of the service, though airmen were wounded on occasion, and such accidents occurred as the stoppage of the motor, involving a long glide to earth. Fortunately in the latter case the descent was finished within the shelter of the Italian outpost lines. Thanks to the work of the air scouts in kite balloons, aeroplanes and dirigibles, the Italian generals were regularly informed of the enemy's movements and strength, both at close quarters and at a distance, and the country between the coast and the mountains of the Hinterland was carefully explored and its main features noted, these notes enabling corrections to be made in existing maps. This could not possibly have been done by methods of cavalry reconnaissance under the circumstances and would have cost the lives of many men and horses in the attempt. Whether similar results could have been obtained if the Turks had been able to oppose aircraft with aircraft is difficult to say; and on the vexed question of aerial combat, as of practice with specially devised guns against aeroplanes and dirigibles, there is as yet no information available. Even the Turko-Balkan campaign has added so far nothing to our knowledge of these matters. No practice under peace conditions is of any use, since one cannot use aeroplanes or airships, proceeding at speed under human guidance, as targets like the "running man" on a rifle range, and experiments against towed kites and captive or drifting balloons are quite inconclusive.

Possibilities of the Giant Dirigible.

As regards the possibilities of the various types of aircraft, under favorable conditions of weather, for scouting purposes, we know that the airship has many advantages over the aeroplane. To begin with, its radius of action is enormously wider. The Zeppelin airships now building will, it is understood, be able to travel 60 miles per hour, but even the present "L. I." is capable of 50 miles per hour, and on October 13th and 14th, 1912, traveled 1,037 miles in 31 hours, including an overland and oversea voyage, experiencing both thick fog and clear weather. Besides a full crew, sufficient to work the vessel in watches, a staff of special reconnaissance officers, photographers and gunners, with apparatus for visual signaling, wireless telegraphy (300 miles range and more), search-light, bomb-dropping apparatus and machine guns, it can carry sufficient fuel for a 40 hours' voyage; a margin of 4½ tons lifting capacity (over and above the weight of the fuel) allows for ample supplies of explosives, provisions and water-ballast. Such a vessel can stay aloft for several days, if the amount of fuel consumed can be reduced by hovering and drifting with favorable winds. It can remain stationary for reconnaissance, photography or bomb-dropping, consequently affording a better platform for these purposes than the aeroplane.

While the aeroplane is of questionable utility for night-work, the airship is able to travel as well by night as by day, and it affords greater facilities for navigation by compass or the stars. It is certainly liable to lose gas by day, if considerable changes of temperature occur, owing to alternation of sunshine and cloud, but there is no loss by night. In daylight it can remain at 3,000 to 6,000 feet above the earth, practically safe from artillery fire, and at night it can descend to 1,000 feet and hover over a locality, with stopped engines, in order that scouts may employ both ears and eyes in their work of reconnaissance. When it is necessary to keep up a continuous service of aerial protection, the dirigible involves comparatively little strain on the personnel, whether crew or observers, whereas the expenditures of energy and nerve-force and the exposure of pilots, and even to some extent of

(*Concluded on page 325.*)

Harnessing Nature

Can the Free Energy of Space be Utilized?

By Waldemar Kaempffert

IN a few centuries the world's coal mines will be exhausted. Whence shall we derive the energy to turn the wheels of industry? By harnessing nature, is the answer. Long before we took stock of our fuel supply and found that we must husband what little we have left, scientific dreamers wondered whether natural forces could not in some way be utilized. To be sure, the potential energy stored up in every combustible is a natural force; however artificial our engines may seem, their power is nevertheless ultimately obtained from the sun. But that power is released and applied only by complicated and cumbrous mechanism that wastes many times more energy than it delivers. Why should it not be possible to tap the free energy of space, the energy with which the sun, for example, incessantly bombards us? Can not some engine be devised to transform and make available the apparently inexhaustible supply of energy liberated by every atom of radium? To answer questions such as these with anything like satisfaction is impossible. Yet they are discussed by the most distinguished physicists of the day, and therefore they acquire a dignity with which they might not otherwise be invested. At the fourth annual meeting of the British Science Guild, for example, the whole vast subject of harnessing nature was considered and a committee of seventeen was appointed to report upon it. Among the members of that committee were such distinguished scientific men as Sir William Ramsay, Hon. R. J. Strutt, Prof. Vivian B. Lewes, Sir Charles A. Parsons, Mr. Dugald Clerk, and Dr. Hele Shaw. The committee has not yet handed in its final report, but it has done enough to show how wonderful are the possibilities of engineering when combustibles will no longer be available and along what lines the investigator must work if success is to be attained.

Water Power.

The only natural source of free energy that engineers have thus far successfully utilized is water power. How they have gone to work is so old a story that it need not be retold here. Their task was simple. The crudest kind of bladed wheel ground corn centuries ago. The great turbines of Niagara Falls are merely improvements upon it.

A water fall is a ready-made solar engine, the only commercial solar engine that man has succeeded in utilizing. No machine has ever been designed or ever will be designed that will surpass the water fall in efficiency. The sun pumps the water of ocean, lake and river on mountain tops, and the force of gravity drops the water again to its original level. The cycle is endless. Because there are no valves, no shafts, no connecting rods, no thermal losses, the efficiency is one hundred per cent. It has been calculated that the total energy of these atmospheric deposits amounts to 100,000,000 horsepower. With the advent of electricity and its introduction into industry part at least of this energy is being used—the sole example of the successful use of nature's free energy.

Putting the Sun to Work.

But why not go directly to the sun? Its radiation has been measured and expressed in engineering units. In his Royal Institution lectures of 1911, Sir J. J. Thomson stated that, shining from a clear sky, the sun sends to the earth energy at the rate of 7,000 horsepower an acre. Moreover, as the temperature of the sun is at least 6,000 deg. Cent. this energy must arrive in a highly available condition; theoretically it ought to be almost wholly convertible into mechanical work. No wonder that the construction of a commercial solar engine has been one of the most fascinating problems that ever engaged the attention of inventors.

Up to within recent years the most elaborate experiments on record were those of Capt. John Ericsson, designer of the famous "Monitor." On a rainless strip eight thousand miles long and one mile wide, extending almost continuously from Africa into Asia and from South America into the United States, solar heat enough is wasted, he figured, to drive 22,300,000 solar engines of one hundred horse-power each, nine hours a day.

In endeavoring to utilize a very small part of this truly staggering amount of wasted energy, Ericsson worked persistently from 1865 to 1878 and built in that time no less than seven sun engines. He adopted the rather obvious method of concentrating the sun's rays on a boiler when he was driving his engine by steam, and on an air chamber when he employed one of his "caloric" engines. Eventually he succeeded in obtaining about one horse-power for every one hundred square feet of reflecting surface. Finally he came to the conclusion that the scheme was impracticable. "The fact is," he frankly admitted, "that although the heat is obtained for nothing, so extensive, costly and complex is the concentration apparatus that solar steam is many times more costly than steam produced by burning coal."

Since Ericsson's day other attempts have been made along different lines. Readers of the SCIENTIFIC AMERICAN are familiar with the proposals of Mr. Frank Shuman, Prof. Reginald Fessenden, and Messrs. Willsie and J. Boyle, Jr. Because their apparatus has been described in these columns at sufficient length it is unnecessary to dwell upon it again. In all these three solar power plants, the "hot box" of de Saussure, Langley and other pioneer solar physicists is employed. In other words, a film of water is heated in a glass-covered trough. The heat impounded by the trough is sufficient to raise the water to the boiling point, or very near it. Mr. Shuman has designed a low-pressure steam engine in which this hot water is flashed into steam. Messrs. Willsie and Boyle employ their hot water to vaporize a liquid, which has a boiling point lower than that of the water, a liquid such as sulphur dioxide. The vapors which are given off from the sulphur dioxide at a pressure of 215 pounds to the square inch drive a specially designed engine and are then returned to be used over again. The water which has given up its heat to the sulphur dioxide is sent through the hot-box again to absorb more heat from the sun.

Since the sun does not shine by night even in the desert of Sahara, a storage system must be devised—a piece of apparatus that can be charged with excess power and tapped at will in sunless periods. Compressed air tanks, storage batteries charged by dynamos driven by the solar engine, water pumped into a reservoir by a solar pump and used later to drive a water wheel, have all been proposed. Messrs. Willsie and Boyle store their hot water in a well insulated tank, so that it retains its heat over night and is always hot enough to vaporize sulphur dioxide. Mr. Shuman has also designed an insulated tank or boiler for storing hot water.

Prof. Fessenden, in the solar power scheme described and illustrated in the SCIENTIFIC AMERICAN two years ago, considered it more expedient to pump water into a reservoir and let it drop a considerable height against a water wheel. He, too, heats his water in a thin film under glass, causes the steam thus generated to drive a low-pressure pump directly, and thus fills his reservoir with water. In the plant illustrated in the SCIENTIFIC AMERICAN he showed a way of lifting Channel water to the top of the Dover Cliffs, so that it would flow back through a pipe and drive a water turbine at the bottom of the cliff. In conjunction with each solar plant a windmill is to be operated, so that, as he explains, "much better all-day and all-year efficiency will be obtained, because the wind is, as a rule, more effective during cloudy weather and at night time, i. e., when solar radiation is diminished or absent."

If we can extract heat from anything we can perform work. Water can be boiled without fire simply by reducing the pressure of the atmosphere. Since the atmosphere contains a certain amount of heat, why not extract it, as it were, and drive an engine? That is a proposal which Mr. Nikola Tesla has made. The direct utilization of the sun's heat after the manner of Ericsson, Shuman, and others seems to him commercially hopeless, however practicable it may be on an experimental scale. Moreover, he cannot reconcile himself to the idea that the entire manufacturing interests of the world must be transplanted to Arizona, southern California, Egypt, or the Sahara desert when the world's coal supply is exhausted and the solar engine is at last realized. Industry seems to be identified with the temperate zones, where sunshine is intermittent. The periodicity of sunshine, with which all solar engineers must reckon, he finds an insuperable difficulty. Moreover, it seems inept to him to convert the intense heat of the sun into low-temperature heat, of which only a small fraction can ever be recovered as mechanical work. In his opinion, the only direct way of converting solar energy into work is to tap the heat units of the atmosphere, heat units available at all times, in fair weather as well as foul, in summer as well as in winter. There is no need to invent storage systems; for the atmosphere is its own storage tank. This is, to be sure, but a thermodynamic dream as yet, but a dream which, however wild it may seem, is nevertheless worthy of at least academic discussion.

The Photo-chemical Power Transformer.

Every living organism is a crude kind of solar engine. We are all dependent on the product of the soil for our existence, and that product in turn represents so much solar energy chemically stored up. A grazing cow is a living engine that converts solar energy into work. The solar energy that has caused grass to grow is turned to practical account whenever she flicks a fly from her back. Prof. V. Coblentz has suggested that perhaps a chemical substance may be discovered, which, when exposed to the sun, is transformed into a stable substance capable of giving up its energy for subsequent consumption, a substance more highly efficient than grass and capable of releasing its energy perhaps in an electrical way.

This idea was further developed in a profound analysis of photo-chemical problems before the recent International Chemical Congress by the distinguished Italian chemist, Prof. Ciamician. An obvious cycle, he suggested, was the use of mineral fertilizers to raise a harvest, which, dried by the sun, could be converted entirely into gaseous fuel, the ammonia being fixed and returned to the soil as fertilizer, together with the ash. He also deemed it possible to produce the things we need directly without the intervention of much factory machinery. If ammonia can be directly obtained from atmospheric nitrogen and hydrogen—the recent technical achievement of a great German chemical manufacturing company—why should it not be possible, he asks, to utilize solar energy in connection with catalytic substances and thus artificially reproduce plant processes on an unprecedented scale? A photochemical laboratory in northern Africa might thus produce immediately useful substances now supplied only after much coal-burning, engine-driving and mechanical handling of raw material. A meadow is not a highly efficient transformer of solar energy, but the manner in which it synthesizes the chemical elements stored up in the earth with the aid of sunshine might well be artificially reproduced, and the solar engine itself abandoned except for purely thermodynamic purposes. If a plant can reverse the process of combustion, if it can transform the carbon dioxide of the atmosphere into starch, simultaneously setting free oxygen, why can't man adopt the same principle with success? At all events, Prof. Ciamician holds that it lies within our power to make plants produce abundantly the things we need. The possibility is indicated when we consider the ease with which we have increased the amount of sugar in the sugar beet and the percentage of protein in wheat.

The Energy of the Rotating Earth.

In an introductory lecture to the engineering classes at University College, London, Prof. J. A. Fleming, in considering the sources of energy available to mankind, pointed out that the earth is a great flywheel. It whirls along in its orbit with a velocity of about twenty miles a second or 1,200 times that of an express train. Its rotational energy is a hundred thousand million billion horse-power hours; but the total orbital energy or energy of motion in its orbit is ten thousand times greater. "Suppose," said Prof. Fleming, "suppose we could in some way or other slow down its rotation so as to make the day just five minutes longer. . . . This would decrease the earth's angular velocity by about one third of one per cent and decrease the angular energy by about two thirds of one per cent, or say by 1/150 part. If then we could capture and store up the difference in the rotational energy in the two cases, it would give us about six million billion horse-power hours, or a billion horse-power for seventy thousand years. The energy we can obtain by the combustion of all the one thousand million tons of coal at present raised per year, sinks into insignificance compared with the enormous energy which would be set free by an almost imperceptible lengthening of the earth's diurnal rotation."

Prof. Fleming was not rash enough to indicate in what manner this unthinkable amount of energy could be utilized. Those who will attempt that will find themselves engaged in the mad task of designing perpetual motion machines.

The Energy of the Atom.

If Ramsay is correct in stating that copper and lead can be disintegrated, have we not here a source of energy? Sir William Ramsay has himself effectually disposed of that possibility. First, all metals, except gold and platinum, he has pointed out, are produced by the combustion of fuel, or, it may be, by electric power derived from turbines and dynamos. Hence they must be more costly than the means used in their produc-

tion; to produce them, not merely must energy be used, but also some must be degraded, and lost as heat. Labor, too, is expended in their production. On the supposition of change with evolution of energy, they would give out no more than has been put in, in converting the ores into the metals. Lastly, supposing that this compound can be induced to change, under the action of ultra-violet light for example, the change is too slow to be effective as a source of energy; and ultra-violet light itself is produced only after much energy is expended.

Experiments conducted by Mr. Nikola Tesla with electromotive forces of 20,000,000 volts have convinced him that if 100,000,000 volts could be produced it might be possible to break down the atomic structure of any element and thus liberate a certain amount of energy. "But," he told the writer of this article, "even if the feat could be accomplished and sufficient energy set free, there still remains the enormously difficult problem of devising a means of utilizing the energy in a practical way."

Prof. J. A. Fleming suggests a somewhat similar course. "It is now pretty generally recognized," he argues, "that an atom is a complicated structure, a sort of solar system in miniature composed of revolving electrons. It may be possible to break down the structure by the action of impulses due to concentrated electric waves of the right period, setting up vibrations, which are resonant with some natural period of the atom, just as it is possible to break down a suspension bridge by a number of men jumping on it in time with its natural period of oscillation. If then the atom were to break down, the energy liberated might be far greater than that applied to it in the form of the resonant impulses."

Sir William Ramsay is undoubtedly right in maintaining that no source of energy, capable of being converted into work on a large scale, can be looked for, so far as the transmutation of matter is concerned. "The question is not—can it be done? but—does it pay to do it? And to the last question the answer is emphatically *no*."

Radium as a Source of Energy.

So minute a quantity of pure radium as one gramme (one twenty-eighth of an ounce) yields 118 calories an hour, 2,900 a day, or nearly one million a year. A ton of radium, according to Sir William Ramsay containing a million grammes, would give one million million calories per year. As one gramme of coal in burning evolves about 8,500 calories, one ton would evolve one million times as much, or 8,500,000,000, which is only the 117th part of that evolved by the radium in a year. Moreover, the radium after the year has suffered merely a minute loss of weight; roughly speaking, about 1/3,500th of its weight has disappeared; hence before it was all "consumed" it would have evolved $117 \times 3{,}500 = 460{,}000$ times as much heat as an equal weight of coal. Add to this the fact that coal is utterly consumed in a few hours, but that rate of change of radium is all but imperceptible, and the superiority of radium over coal, weight for weight, is still more apparent.

Unfortunately, radium is about the scarcest producer of energy in the whole world. Radium is the offspring of uranium; it does not occur apart from uranium. Sir William Ramsay places the supply of uranium in its ores at about one million tons. Since the amount of uranium contained in the "kulm" shale of Sweden is under 0.5 per cent he concludes that the amount of radium metal in the whole world is not more than 500 pounds—too insignificant, in a word, for serious consideration as a substitute for coal. Not more than 125,000 tons of coal would be saved by utilizing the energy in 500 pounds of pure radium. The railway locomotives of the United States burn more than that quantity of fuel in a year. Besides, the energy in the five hundred pounds of radium cannot be liberated quickly, but must be spread over a period of centuries. The late Prof. Curie once remarked that he would not venture into a room containing only a pound of radium, so extraordinarily intense is its action. Hence, even if it were possible to hasten the discharge of radioactive energy, the engineers of a radium power plant would have to be recruited from the members of Stevenson's Suicide Club.

The Internal Heat of the Earth.

It is a matter of common knowledge that in sinking mining shafts there is a rise in temperature of about 1 deg. Fahr. for every 60 feet, down to a certain depth. Active volcanoes afford still more striking evidence of the earth's internal heat. Have we not here an inexhaustible source of energy? We have, but it is difficult, if not impossible, to utilize it. If the prime requisite in making use of any source of heat is to obtain good conditions of thermal interchange with it, an insuperable obstacle would be found in the poor conducting qualities of rock. Only by fluid convection would it be remotely possible to obtain communication with the earth's stores of heat. In considering these possibilities, the Hon. R. J. Strutt points out that hot springs, while they have been utilized from time immemorial, are too diminutive. The perpetual streams of molten lava that flow into the sea in certain localities, as at Stromboli, might perhaps be utilized, he ventures, "but the opportunities for applying the method would scarcely be extensive enough to encourage inventors."

Why not pump water down to the heated interior and return it to the surface at a high temperature? Here again Strutt sees no possibilities. The pipes would have to be kept immersed in molten lava; no sufficiently rapid transference of heat to them from solid rock would be possible. For the same reason, he states, the pipes must not be cooled down by the water flowing through them sufficiently to cause the surrounding lava to congeal. Can the pipes endure the prolonged action of molten basalt? Wrought iron might in Strutt's opinion. "On the other hand, the margin of difference between the melting point of basalt and of iron is not very great, and lack of stiffness in iron pipes at such temperatures would undoubtedly introduce the most serious difficulties." Even if the attempt be made by directly attacking a volcanic crater the engineering difficulties would be enormous.

Similar conclusions were reached by Sir Charles A. Parsons in a presidential address to the engineering section of the British Association for the Advancement of Science. He discussed the feasibility of constructing a bore hole twelve miles deep. While the feat could be accomplished, and while the temperature of the rock at that depth is probably 272 deg. Fahr., the undertaking would involve an expenditure of millions.

The Future of the Windmill

A FEW years ago a collective report was made by American consuls throughout the world on the use of windmills in their several districts, and the prospects of increasing the sales of American windmills in foreign countries. At that time the manufacture of windmills in this country had increased fourfold in ten years, indicating a rapid growth in their use by our own people. However, the report was, on the whole, rather discouraging. The use of windmills was found to have greatly decreased in the Old World. This was notably true in Holland, the country with which the windmill is traditionally associated. For the great national task of draining the polders windmills were being rapidly replaced by steam pumps.

The greater number of European windmills were erected before the days of steam. This fact, together with the relative inefficiency of the old-fashioned European windmill, shows that the decline in the use of these devices abroad is no indication of the future in store for the American windmill.

The American farmer uses the windmill chiefly for pumping water, both for domestic purposes and for irrigation. To some extent it has been used for driving the minor machinery of the farm. Attempts to use it as a means of generating electricity for lighting and power purposes have hardly passed the experimental stage. That this will come in time seems inevitable, and herein probably lies the greatest future utility of the windmill as an adjunct in farming, as well as in other occupations.

The future developments in this line will be conditioned by the meteorology of the country, and in this connection it is important to have accurate statistics of the average force and constancy of the winds in all sections. Such information is presented in brief form by Mr. P. C. Day of the Weather Bureau in an article published in the last Yearbook of the Department of Agriculture. A number of charts bring out clearly the great diversity in "windiness" in different parts of the country. Mr. Day takes a most hopeful view of the value of the wind as an asset in American agriculture.

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT Mr. W. M. Booth discusses industrial efficiency from the point of view of the chemical engineer.—Mr. P. W. Wilcox describes a new system of two-rudder control for aeroplanes.—E. Hesse contributes an article: "The Housefly and How it Spreads Disease," in which he points out as a possible remedy against the fly pest a fungus which is parasitic upon the fly and kills it.—W. M. Davis writes on the theory of the origin of coral reefs by subsidence.—Th. A. Watson recites some interesting and amusing incidents from his connection with the early development of the telephone.—Walter Feld describes the direct production of ammonium sulphate from hydrogen sulphide and ammonia.—Sir J. J. Thomson's series of lectures on "The Structure of the Atom" begin in this week's issue.—Cooling towers are of importance in many manufacturing plants. A special system of such towers is described, and their efficiency discussed.—Mr. N. S. Neumark concludes his article on Peroxides and Persalts.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Clipping a Hedge With a Torch

To the Editor of the SCIENTIFIC AMERICAN:

The day fast approaches when the "hedge" that incloses our suburban homes is about to start in business and cause the long-suffering commuter much concern. Hence the question: Has any of your readers ever tried to "clip" a hedge with a painter's gasoline torch? "HEDGE-HOG."

New York city.

The Mississippi Floods

To the Editor of the SCIENTIFIC AMERICAN:

I am sorry to note the stand you take in the matter of straightening out a river, in your otherwise sane views of flood restrictions.

The problem of the Mississippi is identical with that of the brook, save in magnitude and constant level at outlet. A straightened bed will lower the flood crest by drawing the advance waters of a flood from hours to days sooner than if left to its tortuous course. Thus, a large volume of oncoming waters is early disposed of, and the flood crest flattened and drawn or lengthened. This is surely a well-known fact, and easily demonstrated, fortunately.

The importance of bank erosion is a close second to that of flood restriction, and is happily prevented by simply straightening the channel. Surely this plain problem does not call for very much "gray" matter. Begin at the mouth, straighten channel any distance, make waterway wide enough and dike high enough to take flood, with a good margin of safety added.

Littleton, Del. C. A. ZANDER.

Improvement in Carbureters

To the Editor of the SCIENTIFIC AMERICAN:

Much is being said about the auxiliary air valve working in connection with the carbureter. I have used such air valve three years, the valve being under hand control. By its use the increase in mileage runs from sixteen to twenty-two and twenty-five miles per gallon. The machine is small and the roads good.

A simple device for air hand control can be put on any car without much trouble. Cut a hole in a suitable place between the carbureter and engine, and cover it with a cone valve that can be opened or closed by a lever on the steering post. For a small car a three eighths-inch hole covered with a cone valve will serve.

Experience on the road will tell when to open the air supply; if opened too soon the engine will miss; if opened too wide the engine will miss. The harder the engine is working and the faster it is going, the more the valve can be opened.

The use of the auxiliary air valve is not original with me. I got the idea from Homan's work on "Self-propelled Vehicles," using my own plans to accomplish the job. The material cost thirty cents. The work was done in a carpenter's shop; rather crude, of course, but answers an excellent purpose.

Pasadena, Cal. WILLIAM YOUNG.

That Granite Chipping Machine

To the Editor of the SCIENTIFIC AMERICAN:

I notice the article in your correspondence column of February 22nd, in which a machine is wanted for chipping granite cubes, which is certainly much to be desired.

This city alone uses from eight to ten million a year, and nothing else seems to be able to stand up under heavy conditions of traffic. Advance has been made in every line of industry except the granite block industry, which has stood still for upward of two hundred years, save that drilling is now done by pneumatic tools instead of hand drills; but nothing has as yet been devised that will even compete in cost of production with the present extravagant methods of hand labor. There are firms in this line in Chicago who would no doubt advance money for any plan that appeared practical, and pay handsomely in royalty for machines or any contrivance that would equal the present hand labor cost of getting out these granite blocks.

Throughout all this middle West there are two sizes in general use. One is 8 inches to 12 inches long, 4 inches to 5 inches in width, and 5 inches to 5½ inches in depth; the other is 6 inches to 10 inches long, 3¾ inches to 4¼ inches in width, and 3¾ inches to 4¼ inches in depth.

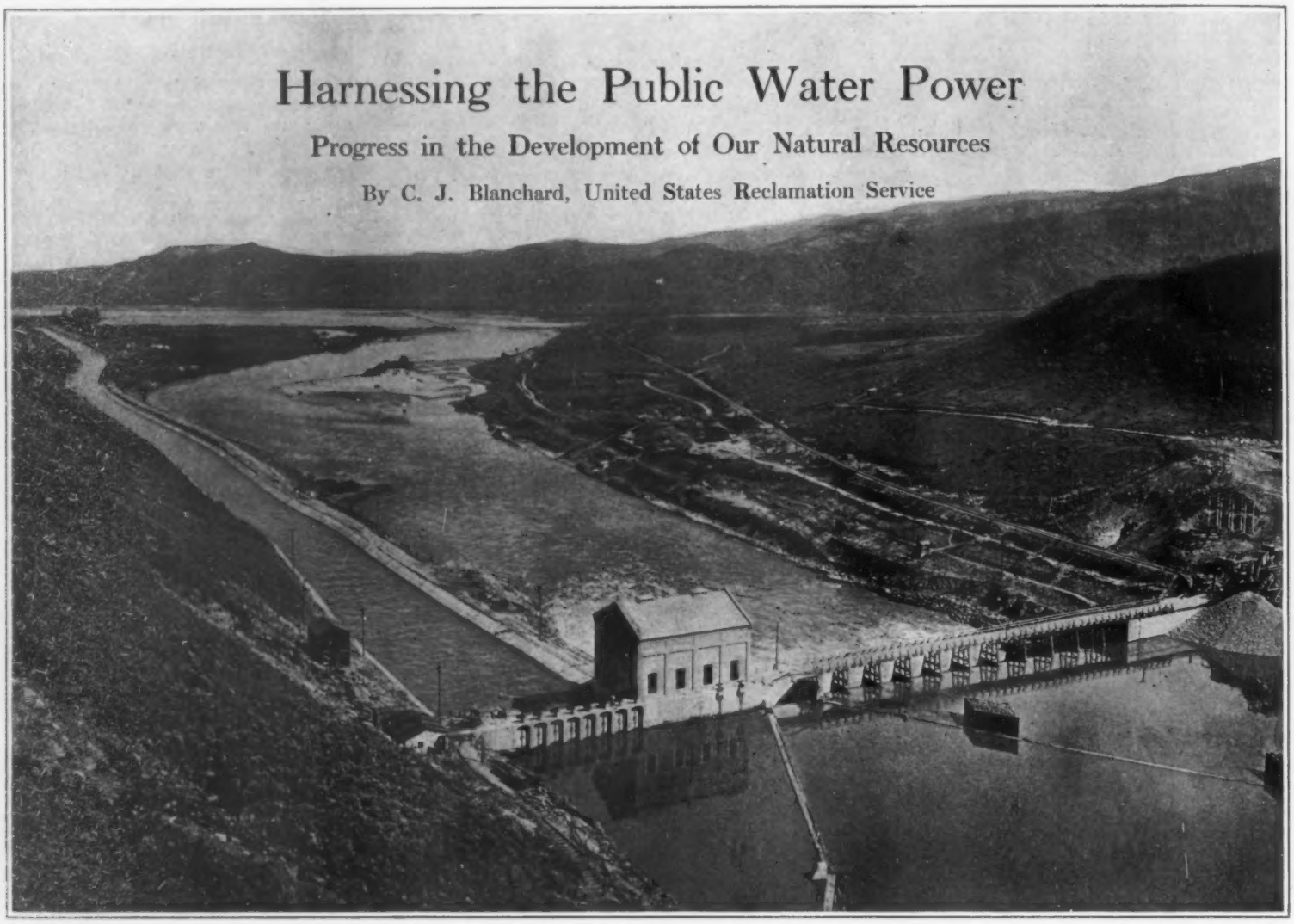
To the man or the men who can devise something practical along this line, a fortune awaits them.

SUPERIOR CONSTRUCTION COMPANY,
Chicago, Ill. Per J. A. MCGINN.

Harnessing the Public Water Power

Progress in the Development of Our Natural Resources

By C. J. Blanchard, United States Reclamation Service



The Boise project, Idaho. Bird's eye view of the completed power plant and surroundings.

UPON the adoption by Congress of a comprehensive and practical water power policy depends to a great extent the future development and progress of a large part of the West, and in a somewhat lesser degree of many parts of the East, South and Middle West. The time is ripe just now for an adjustment of the differences which have existed between the federal authorities, the States and private interests, and a definite policy is looked for in the near future. Indeed, a long step in this direction was taken during the closing hours of the last administration when plans for State and federal co-operation were formulated and the Department of the Interior in an agreement with a large power company in Montana secured recognition of its right to make certain provisions for the regulation of rates to govern the operations of this company which desired to use some of the public domain. As a result of this agreement the electrification of probably four hundred miles of a transcontinental railway is practically assured and a new market for the "white coal" of the West is provided. A precedent has been established and the bugaboo of Government regulation tying up development has been laid on the shelf for the time being. If one of the largest power companies in the West and a transcontinental railroad have found it possible to enter into an entirely satisfactory agreement with the Department of the Interior, notwithstanding the present notoriously inadequate laws, future complaints by promoters and exploiters that their plans for development are prevented by departmental red tape will perhaps not be accepted with the same confidence by the public and the press. It has not always been the fault of the Department that private enterprises have been checked and halted. More often the fault has been with Congress, which while enacting laws for withdrawals and reservations, has persistently declined to provide legislation to enable the Department to unlock the storehouse in order to permit utilization and development for the public.

Representatives of the Departments of the Interior and Agriculture during the past year held numerous conferences which resulted in a comprehensive revision of the regulations governing the water-power permits in national forests and on the public domain generally. Later a largely attended conference was held with representative water-power interests and of the State conservation, water, and varied commissions of California. There were discussions of the relations between the State and national governments with respect to water power and modifications in the laws and regulations in order to co-ordinate the functions of the nation and the States. This conference was extremely illuminating in that it fully demonstrated the feasibility of effective co-operation.

Government Construction of Power Plants.

In the working out of a definite plan for the utilization of our natural resources and particularly the water powers, only one federal bureau has been actually engaged in the engineering work of developing power. The Reclamation Service, organized in 1902 for the purpose of making habitable large areas of irrigable public lands, has constructed a number of power plants and has launched the Government in the power producing business in several localities. Originally the idea of power development was solely for the purpose of pumping water to lands above the reach of the gravity canals, but wise management decreed when there was demand for surplus power, that all such power which could be economically developed should be provided for in the construction of the plant. In this way the Government has found itself in the field as a maker and seller of electric power. It is a rather advanced step in governmental activities, but no one has yet seriously questioned its practicability and certainly no one can gainsay its success financially. It is understood that the Government's control of these public utilities is not to be permanent, as it is contemplated in time that their operation and maintenance as well as the revenues will be turned over to the people who have assessed themselves to repay to the Government its investment. The Government in this connection might be regarded as in the position of a contractor who has built and is operating its plant until its owners have met their obligations to him.

The great Minidoka dam across Snake River.

The following table shows the present condition as well as the possibilities of power development on the reclamation projects:

Project.	Power Developed, H. P.	Possible Power.
Ariz., Salt River	9,030	20,000
Ariz., Yuma	....	600
Cal., Orland	....	....*
Colo., Uncompahgre	....	10,000
Colo., Grand Valley	....	2,000
Idaho, Boise	3,000	3,000
Idaho, Minidoka	10,000	30,000
Mont., Huntley	380	380
Mont., Lower Yellowstone	....	290
Mont., Sun River	....	....*
Mont., Flathead	....	300,000
Neb.-Wyo., North Platte	....	....*
Nev., Truckee-Carson	1,660	8,000
N. Mex., Rio Grande	....	....*
N. Dak., Williston	3,000	3,000
Ore., Klamath	....	....*
Ore., Umatilla	....	75
Utah, Strawberry Valley	1,600	3,500
Wash., Yakima	....	15,000
Wyo., Shoshone	....	....*
Total	27,670	394,845

* Not determined.

Minidoka Project, Power Plant.

The largest individual development of

power by the Government is on the Minidoka project in Idaho, where at the present time 10,000 horse-power is utilized. It might be stated that on this project as well as on all others the primary use of the power is to meet the needs of irrigation. After this need is supplied the surplus, if any, is marketed commercially for the needs of the public and private interests.

The Minidoka power house is located in the great Minidoka dam across Snake River. The water which moves the turbines is water which does not belong to the Government, but is decreed by prior right to irrigation projects below, in the neighborhood of Twin Falls. Before it is permitted to pass to its rightful owners the Government exacts a toll of 10,000 horse-power, which is advantageously applied to many uses on the Minidoka project. The first and greatest use is for pumping upon high lands. The current is generated in five separate units of a total of 7,000 kilowatts and transmitted about 13 miles at a pressure of 23,000 volts, to three pumping stations which pump about 650 cubic feet per second to a height of 31 feet above the gravity canal. At this level 10,000 acres are irrigated, the balance of the water being then lifted 31 feet higher, and part of it applied to 15,000 acres. The remainder is then lifted an additional 31 feet and supplies 23,000 acres. This constitutes the largest pumping plant for irrigation in the world. Notwithstanding the large utilization of the power for irrigation needs there remains a substantial surplus for which it was necessary to establish a market. Being a constant force, and not limited as on several other projects to the irrigation season, it was important that arrangements should be made to dispose of the unused power. The heaviest demand for electrical energy occurs during the irrigation season. In the winter this demand ceases entirely. As the flow of the stream continues throughout the year, power is available in winter as well as in summer, and it has been deemed expedient to make special inducements to the towns on the project to use it. Encouraged by a very low price, citizens of Burley, Heyburn and Rupert have made contracts with the Reclamation Service. At the prices made to them heat can be furnished by means of electric heaters at approximately the price of coal. Its greater convenience and cleanliness has led to such use to a considerable extent. The demand is steadily growing, but still is behind the supply. In addition to heating and lighting the stores and homes, the family cooking in many homes is now being done by electricity.

A very advantageous contract was made a short time ago with a newly established sugar factory at Burley. The first month's rental of power produced a revenue of $1,600 to the Government.

An effort is being made to secure the consumption of the balance of this water power by encouraging the installation of a manufactory of nitrogen products for fertilizer and other uses. It is believed that these negotiations will prove successful, as well as others for establishing special industries adapted to intermittent use of power.

The Salt River Project, Arizona.

On this project, by reason of its large storage, the all-year-around irrigation, and numerous drops in the main canals, the power possibilities far exceed the requirements of irrigation pumping. Owing to the varying head in the reservoir, which is to be utilized upon the wheels, the power is fluctuating in character at the Roosevelt dam. This disadvantage is compensated for in a measure, however, by the fact that the demand for power is great and the rate obtainable sufficiently remunerative to warrant an expenditure on the part of the Government necessary to develop a plant of maximum capacity. The surplus power at the Roosevelt dam has been leased to a prominent mining company which, owing to the high cost of fuel, found it profitable to pay ¾ of a cent per kilowatt hour for all power taken under a contract which does not obligate the Government to continuous delivery. This of course forces upon the company the necessity of having in readiness at all times an auxiliary steam plant for operation on short notice. Under this same contract the Government may in time of need use the steam plant of the company for its own purposes. This most fortunate conservation of the entire power possibilities at this point will in the long run prove profitable to the irrigators under the project.

The co-operation of the farmers and their appreciation of the value and importance of developing all the power possibilities in the valley are evidenced by a bond issue made by them recently in the sum of $900,000, which amount is now being expended in accordance with plans of the Reclamation Service to construct a number of power plants in the valley, utilizing the drops in the main canals. One of the canal power plants is serving to supply a local company which delivers power to the city of Phoenix. The revenue to the Government for this power amounts to between $5,000 and $6,000 per month. Another contract has been let to the Sugar Company at 1½ cents per kilowatt hour, another to the town of Glendale at a maximum of 5.51 cents per kilowatt hour, another to the Arizona Alfalfa Mill Company at 1½ cents per kilowatt hour, etc. It is conservative to state that the ultimate gross revenues from the power on the Salt River project will exceed a million dollars annually when the maximum development has taken place.

It should not be forgotten that notwithstanding this large revenue return in the way of cash rental for power, the same plants will pump water from wells to irrigate 40,000 acres. As this land comprises some of the finest orange land in the valley it is safe to say that electric power will in this way add $8,000,000 to the taxable wealth of the valley in land values alone. In producing orchards this land will be worth double this amount.

Strawberry Valley, Utah, Project.

On this project the Government planned its power plant primarily for the purpose of using the electrical energy in the construction of a remarkable tunnel. A description of this tunnel was published in last week's issue of the SCIENTIFIC AMERICAN. It pierces the Wasatch range at a point where the mountain is four miles thick, and conveys the water of a stream formerly emptying into the Gulf of California, into a valley which has no outlet to the sea. From the power plant on the western slope to the eastern portal the distance was 25 miles across a rugged mountain country. The waters of Spanish Fork River were diverted into a power canal which supplied the turbines and about 1,600 horse-power was developed. Part of this power for some time has been leased to the towns of Spanish Fork, Payson and Salem at rates ranging from 8/10 cent to 1 1/2 cents per kilowatt hour, the lower rate calling for a minimum total of $225 per month and the higher rate for $60 per month.

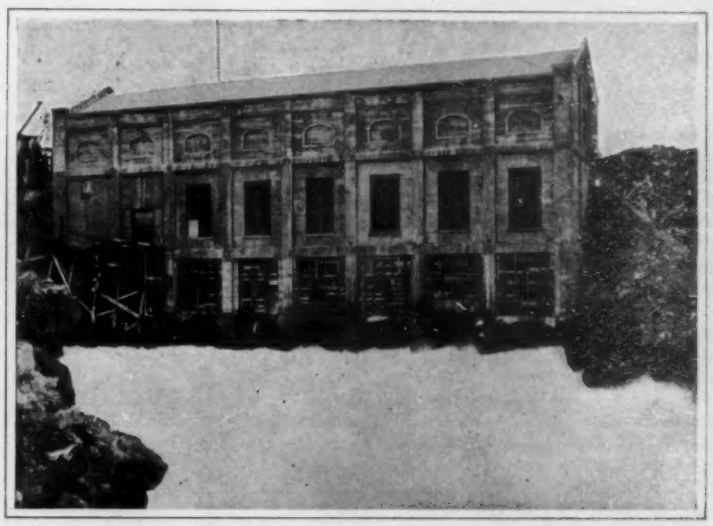
Electric Power for Construction.

The Reclamation Service has not hesitated to install heavy power plants in connection with its construction work in the West. At the present time it is building near Boise, Idaho, the highest dam in the world, and is using for this purpose power transmitted 24 miles from its power plant on Boise River where 3,000 horse-power are developed.

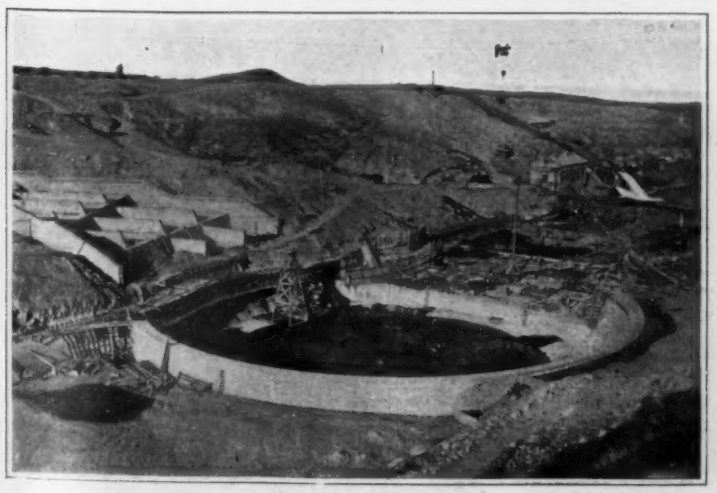
On the Truckee-Carson project in Nevada 1,660 horse-power are generated in the Government plant, a portion of which is required in building the Lahontan

(Concluded on page 323.)

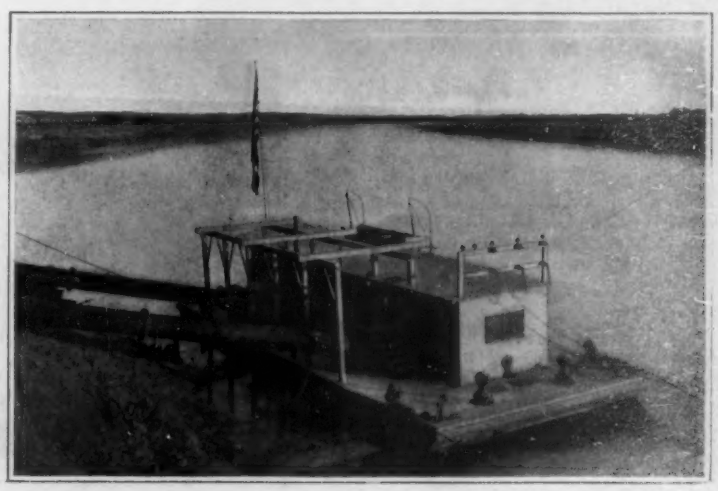
Uncle Sam's coal mine and miners on the Williston project.



Power house of the Minidoka irrigation project.



The spillway pool, Lahontan dam, and the temporary flume.



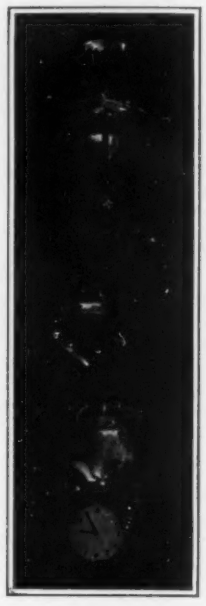
The pump-bearing barge in place with discharge pipes connected.

Type A insulator at 160 kilovolts.

Type C at 265 kilovolts.

Type D (five sections) at 280 kilovolts with connecting hook protected and unprotected.

Type E (8 sections) at 310 kilovolts.



Type F at 300 kilovolts.

Suspension Insulators Suitable for 110,000-volt Transmission

Tests Showing the Weaknesses of Standard Types

By Joseph B. Baker

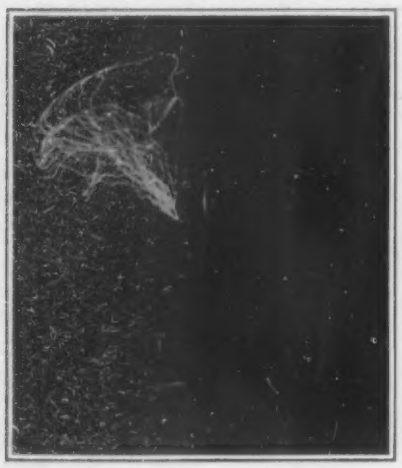
THE constant tendency to increase the voltage of electric transmission lines in order to deliver energy over longer distances and with reduced lines loss has presented for solution many problems of insulation. Both the terminal apparatus and the connecting lines must be insulated so *strongly* that the high pressures employed, and especially the abnormally high potentials due to sudden and transient surges, will not result in breakdown of line or apparatus with its serious consequences. The resistance and dielectric strength of insulations used in electrical machinery at generating and sub-stations—generators, transformers, rotary converters, etc.—has been well worked out by designing engineers and electrical manufacturers in response to the demand for higher and higher voltage equipment; but the protection of the line itself, which is not localized in a small space under a sheltering roof, but runs for many miles through the open country, strung overhead on poles and exposed to all atmospheric conditions, has been in a comparatively backward state. In the old days, when generators and transformers were built with shellacked cotton-insulated wire windings, the lines from the power station were strung on ordinary glass insulators, like those used for telegraph and telephone wires. Later, when better insulations for the machinery were developed in recognition of the fact that high and durable insulation is an essential of continued and economical operation, the pole lines likewise received attention, and special porcelain insulators began to be used; but up to a very recent date high-tension line insulators—nowadays consisting of a series of insulator sections, or "units," affording a long and high resistance barrier against leakage of electricity—have been designed more in accordance with the individual views of their makers than with any definite electrical and mechanical requirements.

In a paper recently presented before the American Institute of Electrical Engineers, Mr. P. W. Sothman of New York describes an investigation of a number of different types of high-tension suspension insulators that he made in order to select a suitable high-tension insulator for a transmission line operating at 110,000 volts—a voltage at which the question of insulation is of the greatest importance, since very little reliable data was available as to the operation of insulators for potentials above 80,000 volts.

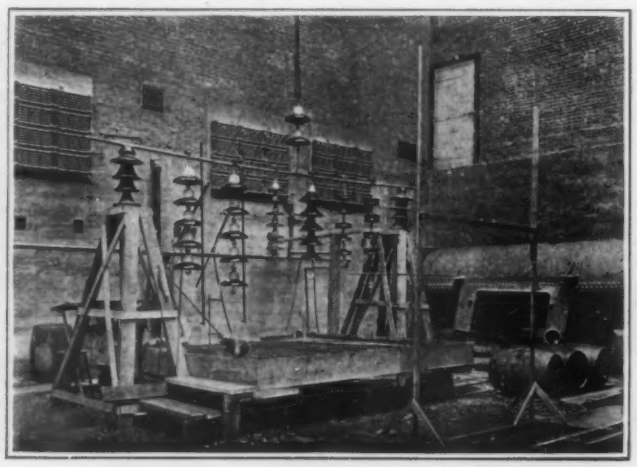
At the outset of this investigation, upon visiting the different insulator factories and witnessing manufacturers' tests on insulators which they proposed for this work, it was clearly seen that the most widely varying methods of testing were employed, so that an insulator showed entirely different results, depending on where and by whom it was tested. There seemed to be no recognized standard in the testing conditions or in the method or interpreting the effects observed; so that it was impossible to arrive at definite conclusions of value in the actual installation of the insulators on a power transmission line. For the new investigation it was therefore determined to establish absolutely unvarying conditions and a definite line of reasoning to be followed in classifying the results obtained.

The testing equipment was one having plenty of *power* (as well as high voltage), and was so arranged that the conditions could be controlled and changed at will. For the open air electrical tests of the suspension insulators, a piece of gas pipe was supported horizontally, resting at each end on a 60,000-volt pin-type insulator at a convenient height above a large platform. The general view of the testing apparatus for suspension insulators shows several of these insulators hung vertically from this gas pipe support; but the insulators were tested one at a time, being placed in the middle of the support while under test, with all the other "candidates" crowded to one side out of the way. The same platform and arrangements were used for the electrical tests of the strain insulators that were investigated, except that the insulator under test was held by tackles in a horizontal position with two other insulators at the ends of the tackles to prevent leakage to ground. For supplying the testing voltage two 50-kilowatt, 150,000-volt transformers were used, giving a maximum voltage of a little over 330,000 (330 kv.). The voltage was controlled by a water rheostat in the low-tension circuit, and readings were taken on a special voltmeter calibrated with spark-gap.

The tests on each insulator comprised "dry tests" consisting of a flash-over test on each section of the insulator in order to exclude defective or punctured units, and a potential test on the complete insulator and on a less number of sections than the total number in the insulator; wet test (insulator exposed to artificial rain); test of all of the insulators in parallel, in order to observe closely relative performance when exposed to identical voltage and conditions; puncture test, with the insulator immersed in oil, since the potential required to puncture a sound insulator is greater than the flashover voltage; test of mechanical strength made with a simple pulling contrivance and dynamometer. An interesting feature of the work was the method of simulating rain, in the wet tests—by an adjustable comb of water-pipe nozzles arranged to shower the "rain" over the insulator. By using two groups of nozzles and adjusting their distance from the insulator under test, the angular precipitation of their streams and the amount of rain supplied per



Type D with hook unprotected.



Testing platform for suspension insulators.

Type D protected by bottle-shaped shield.

minute (measured by a special rain-gage) was placed under perfect control.

The electrical tests illustrated were made at night and in complete darkness, so that distinct observations could be made of all electrical effects by the eye and by the camera; and the photographs which constituted a permanent record of the work were identified by the time shown by a clock placed near the insulator under test. The voltage applied to the insulators was raised by successive steps. Assuming that the luminous display was in proportion to the power leaking past the insulator, it was deemed fair to judge the quality of the insulator by comparing the amount of the display and the voltage that was required to give same. In deciding the net relative value of a given insulator and the influence of its design, other observations were considered: the gradual increase of luminosity, or the appearance of a sudden display, on raising the voltage; the appearance of the display at certain points and not at others on the insulator, etc. The five types of suspension insulators as seen by daylight, and one of the strain insulators that was tested, are shown herewith. The photographs on the opposite page illustrate the performance of the insulators under rain at an angle of 45 degrees and at the rate of one half inch of water per minute.

Type A met the mechanical requirements (by showing a breaking strain exceeding 8,000 pounds), but not the electrical requirements. As the voltage was raised a discharge became visible at 150 kilovolts, and the insulator broke down at 160 kilovolts. The appearance of this five-unit insulator at 160 kilovolts shows the imminent breakdown as due to excessive leakage, the entire insulator virtually becoming conducting. There was another important feature characteristic of every insulator having metal fittings which are in the least degree non-symmetrical about the axis of the insulator, viz., the uneven static field or dielectric stress, most intense at projecting metal points and always causing premature failure of the insulator; the discharge of the insulator is started in almost every case at the projecting point.

Type C insulator also showed up better mechanically than electrically, although it was judged to be too fragile in ordinary handling. It began to show luminous effects at 225 kilovolts, and failed by flashover at 265 kilovolts. This insulator furnishes another instance of uneven dielectric stress, the effect of which is very marked in the reproduced photograph of the insulator in the act of breaking down—particularly at the point of discharge at the left of the cap in the second section from the top.

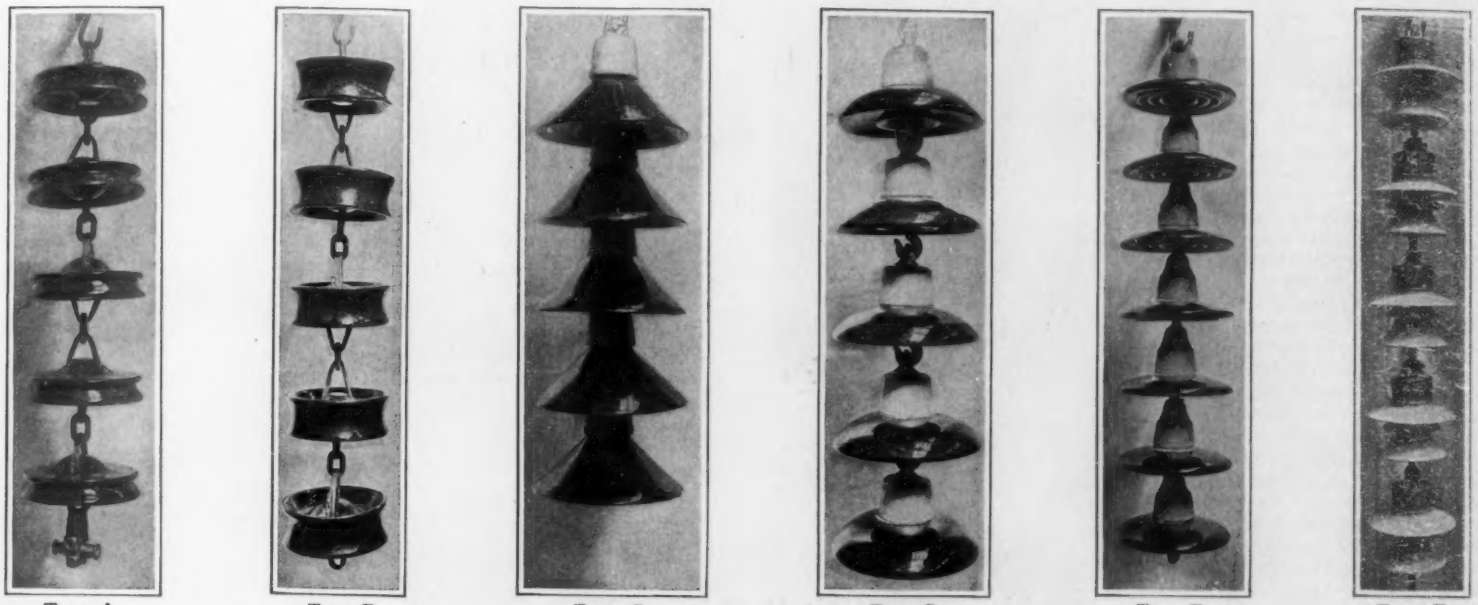
Type D is shown breaking down at 280 kilovolts by flashover. The illustrations of this insulator under test show the localized discharges from projecting points and backs of the hooks used to link the sections together, and the marked effect of protecting the hook by a bottle-shaped metal shield giving a symmetrical instead of a non-symmetrical metal surface.

The eight-unit Type E insulator is shown in the act of failing at 310 kilovolts in consequence of strong leakage from section to section. Heavy discharges are occurring at the cotter pins in the caps.

Type F, an insulator of European design and manufacture, made the best showing of all. The photograph shows this five-section insulator flashing over from section to section at 300 kilovolts. The performance of each section, revealed to the camera by the luminous discharges, presents an interesting study. This insulator failed to meet the mechanical tests only because the cement joining the different pieces in each unit had not properly set. It met the electrical requirements well, showed high-class workmanship and material.

Final selection of the Type E insulator was made in consideration of its good electrical points as demonstrated by the tests on the eight-section insulator, and because better deliveries could be made for the actual line construction than could be expected for the foreign-made insulator, Type F. The large number of open spaces in this unit are of advantage. Although the insulator did not meet the mechanical specification requirements (owing to the fact that the cement had not properly set, the insulator broke at an average stress of 7,650 pounds, the required breaking stress being 8,000 pounds), it was judged to be strong, light, durable, and compact, and susceptible of improvements by slight changes in the design. A subsequent increase in diameter increased the electrical efficiency substantially, and the method of connecting units together was modified so as to present a smooth and symmetrical surface to prevent premature discharge.

The strain insulator Type C did not meet the requirements under the wet test by reason of the excessive leakage at potentials below the specified standard of 220 kilovolts (twice the line voltage). Other types that were submitted for test having also failed, a ten-unit Type E insulator, with a modified design of cap to increase the strength, was finally adopted as the least unsatisfactory strain insulator to use.



Type A. Type B. Type C. Type D. Type E. Type F.

Suspension insulators submitted for test.

Types A, C, D, E, and F are regular suspension insulators, Type B being a proposed strain insulator.

Serious Plight of an Arctic Expedition

A PARTY of Norwegians under Capt. Staxrud has gone from Tromsö to the rescue of the Schröder-Stranz expedition, now supposed to be in dire straits in Spitzbergen.

It will be recalled that Lieut. Schröder-Stranz, a German, recently organized an expedition for the purpose of making the Northeast Passage, an undertaking which, along with much incidental exploring *en route*, was expected to take three or four years. The party included eleven Germans—some of considerable scientific eminence—and five Norwegians. In order to obtain preliminary training under Arctic conditions, a trip to Spitzbergen was undertaken last summer. The party sailed early last August in the ship "Herzog Ernst," a two-master of 61 tons, under the command of Capt. Ritscher, and at first attempted to push north along the ice-obstructed east coast of Spitzbergen. As this proved impracticable, the explorers proceeded up the west coast, and the leader, with three companions, left the ship for a trip over the pack-ice in the hope of reaching and crossing Northeast Land, while the vessel put into Treurenberg Bay to await their return.

On September 10th, as Schröder-Stranz had not returned and the ship was frozen in for the winter, with but a meager supply of provisions on board, all the Germans and two Norwegians set out on an attempted overland journey to the American coal mines at Advent Bay and the neighboring wireless telegraph station at Green Harbor. Only Capt. Ritscher succeeded in reaching Advent Bay, on December 27th, after suffering great hardships. The rest of the party had split up into several detachments and had mostly taken refuge in three Norwegian fishing-huts, widely separated from one another. Capt. Ritscher said that the expedition had only provisions for one month at the most, and that most of the party were, he feared, in the last stages of scurvy. Nothing is known concerning the fate of Schröder-Stranz and his companions; nor of two Germans, Dr. Detmers and Dr. Moesser, who took a different route from the rest of the party after leaving the ship. The situation of the whole expedition appears to be precarious.

The Destruction of the German Dirigible "L. Z. 15."

By Carl Dienstbach

SO many trips have been made in safety by the giant Zeppelin airships within recent months that the discouragement engendered by the frequent wrecks of the past was all but removed. Indeed, German airship builders were taxed to their utmost in the effort to construct new rigid vessels. In the midst of this development came the news of the destruction of the most modern and improved, though not the largest, of the Zeppelins, the new military "L. Z. 15."

How did this accident happen? So far as can be at present determined, this seems to have been what may be called a "legitimate" accident, in other words, an accident no more avoidable than are the accidents to which trains and steamers are subject. It happened during a storm, which played havoc with small shipping in the harbor of Hamburg and caused many deaths from drowning. The safeguards with which all Zeppelins are now provided, as a result of former disastrous experiences, proved inadequate in this particular case. It is now the rule that in a storm a Zeppelin may land only on perfectly level, unobstructed ground, and at a distance, moreover, sufficiently far from any building or other large obstacle which may churn up the wind. According to the orders, the airship is not anchored, but only held, fully manned with engines running. If a heavy gust threatens destruction, the ship is immediately released so that it may seek refuge in the air. When the danger has subsided, the vessel may return, seizing the first favorable opportunity to glide into its shed. The writer saw the "Hansa" enter the shed at Hamburg with the men holding her and running as fast as their legs could carry them, two of the airship's propellers accelerating their progress.

The "L. Z. 15" had been navigating in heavy weather for nineteen hours and had landed only to replenish her fuel, nearly all of which had been utilized in overcoming the storm. The attempt to anchor the ship so as to facilitate the replenishing of the fuel supply was the primary cause of the accident. To have ascended again without sufficient fuel would, indeed, have been hardly less precarious.

The "L. Z. 15" had just been accepted by the military authorities. Competent as her military crew was, there is strong reason to believe that had she been handled by the old, seasoned "air dogs" of the passenger service, many of whom were veteran seamen, she might have escaped injury. As it was, she was wrecked by tremendous gusts which pounded her against the ground before she had been completely anchored. All the machinery and equipment remained intact. No one was injured. It may be safely predicted that in the future a sufficient amount of fuel will be kept in reserve by the captains of all Zeppelins, whether their ships be engaged in the military or the passenger service.

Fighting the Chestnut Bark Disease

The State of Pennsylvania's Work

THE State of Pennsylvania is waging a strange warfare against the spread of a destructive pest known as the chestnut-bark disease. This vigorous attempt on the part of the State to control so virulent a disease is unique in that it is the first organized endeavor of its kind since the disease was first recognized as a serious menace to the chestnut trees in the vicinity of New York city in 1904. Not relying upon mere individual effort, Pennsylvania opened in 1910 an official contest with this pest, and at once began to investigate the disease itself and to control its spread. By this time the disease had been reported from nine States, but with Pennsylvania-like thrift and thoroughness no less than an entire stop in the advance of the disease is sought. This undertaking of the State is being closely watched by pathologists and foresters all over the world, and it is regarded as one of the greatest problems in vegetable pathology, involving the application of means of pest control and extermination which have never before been put into practice on such an extensive scale. Yet vegetable pathologists claim that the control and ultimate extermination of the *Diaporthe parasitica*, as botanists call the chestnut-bark disease, will sooner or later become a real accomplishment.

Viewed even in the most hopeful way this invasion of a comparatively new pest is a fearful portent to the chestnut throughout its entire range of growth and threatens a total destruction of one of our most valuable timber trees. If the blight once gets fairly distributed over all the States in which chestnut trees occur naturally, the problem will become infinitely more difficult. The magnitude of the task of controlling the spread of the disease, which still remains fairly well confined to certain areas, cannot be overestimated. It is realized that this enemy in its condition of advance is too formidable to be coped with even by the thoroughly organized State experts. The disease is decidedly of national importance, and for this reason the United States Department of Agriculture is co-operating in the work, and is doing everything in its power to aid the State in its great undertaking. Literature warning against the pest is officially circulated throughout the chestnut belt and especially within the districts adjacent to the infected regions. The aid of the private owners of timber lands is solicited, and thus far a good many have volunteered to co-operate with the State authorities to remove all advance infections.

The spread of the chestnut blight is westward across the State and the object of the Blight Commission is to check its advance. This is done by felling all infected trees along the border of the blighted zone. The bark is carefully removed from the merchantable part of the trunk and burned together with the branches and small twigs. The bark is also removed from all the stumps and burned. To quote from one of the official reports of the Pennsylvania Chestnut Tree Blight Commission:

"The advance line at the present time extends through eastern Bedford County to central Huntingdon, Center and Clinton, Tioga and northeastern Bradford counties. Up to the present time, over 32,000 blighted trees have been destroyed in the western part of the State, representing over a thousand infected spots. It is expected that by reinspecting these spots another year, the disease will be eradicated from the locality. In this way it is hoped to keep the disease from advancing further across the State."

A great amount of useful, systematic work against this dreaded bark disease has been done since the State undertook its control and eradication. So perfected have the methods become that the sporadic outbreaks along the line of advance of the disease are quickly located and the trees destroyed. Burning is the only practical destroyer of this fungus, and every spot in the forest that is infected is located and the search for them is continued. The expert does his work well, but after him comes a still more competent searcher, and after him possibly still another picked from the long list of available field men. The work has progressed sufficiently far to say that local control of its spread has been effected by this method of double, triple, and in some cases quadruple checking or locating spots of infected trees. It is hoped that by resolutely thorough working from the circumference to the center the authorities will be able to keep the pest securely penned. As in all animal and vegetable pathology, prevention is the best cure. Other methods of controlling its spread are employed, and the one which has invited most extensive speculation in the press is the well-known, though thoroughly impracticable, method of spraying with Bordeaux mixture. The purpose of spraying, which can be done only on a small scale, is to disinfect all wounds or abrasions in the bark, which would otherwise serve as a means of entrance of the spores of the fungus. If the Bordeaux mixture comes in contact with the spores it will prevent their germination. As soon as the spores have gained an entrance in a fresh untreated wound they will germinate and spread very rapidly in all directions in the living inner bark until the mycelia completely girdle the tree attacked. A canker is developed wherever the fungus succeeds in gaining entrance, and if these spots are discovered before the fungus has encircled the trunk or branch they may be removed by cutting out the lesions and water-proofing and sterilizing the wounds. The water-proofing material used is a mixture consisting of two parts of pine tar and one part of creosote, with sufficient lamp black to give desired color. Rosin is also used to supplement the tree-surgery work in the trees that have been sprayed with Bordeaux mixture.

Spraying, as has been said above, is impracticable and is employed only in cases where a few trees are to be saved. It has been demonstrated that spraying acts as a preventive to the germination of the spores of the fungus which causes this trouble. On a large private estate at Kennett Square, Pennsylvania, about fifty large chestnut trees were saved by the spraying process. The trees were sprayed every ten days or two weeks from April to November in 1912. These are now in a healthy condition, and as far as can be determined by close examination show scarcely any signs of blight. A few trees in the woodlot which were not sprayed nor surgically treated had to be removed because they were all badly blighted.

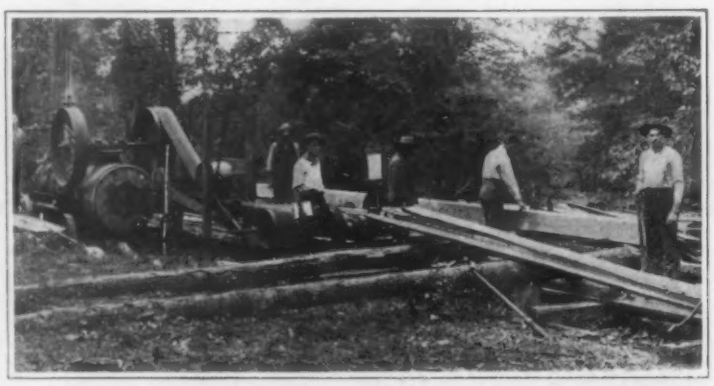
The treatment of cankers is resorted to only in cases of ornamental chestnut trees and of horticultural varieties planted in orchards. The results so far attained with this method of local treatment have more than justified the necessary outlay. Backed thus far by a liberal appropriation the Commission has succeeded in preventing the pest from acquiring very serious headway.

The spread of the blight is westward. To check that spread it is necessary to cut blight-killed chestnut into cordwood; oak and other hardwoods remain.

Sample of tree surgery. A healed wound of canker was removed. The treatment of cankers is resorted to only in cases of ornamental trees.

Spraying with Bordeaux mixture is thoroughly impracticable and is carried out only in cases where a few trees are to be saved.

Spraying outfit used at Kennett Square, Pennsylvania. Spraying can be done only on a small scale and serves merely to disinfect wounds or abrasions in the bark.



Cutting blight-killed chestnut into lumber. The trees are felled along the border of the blighted zone. The bark is carefully removed and burned; the merchantable part is sold.

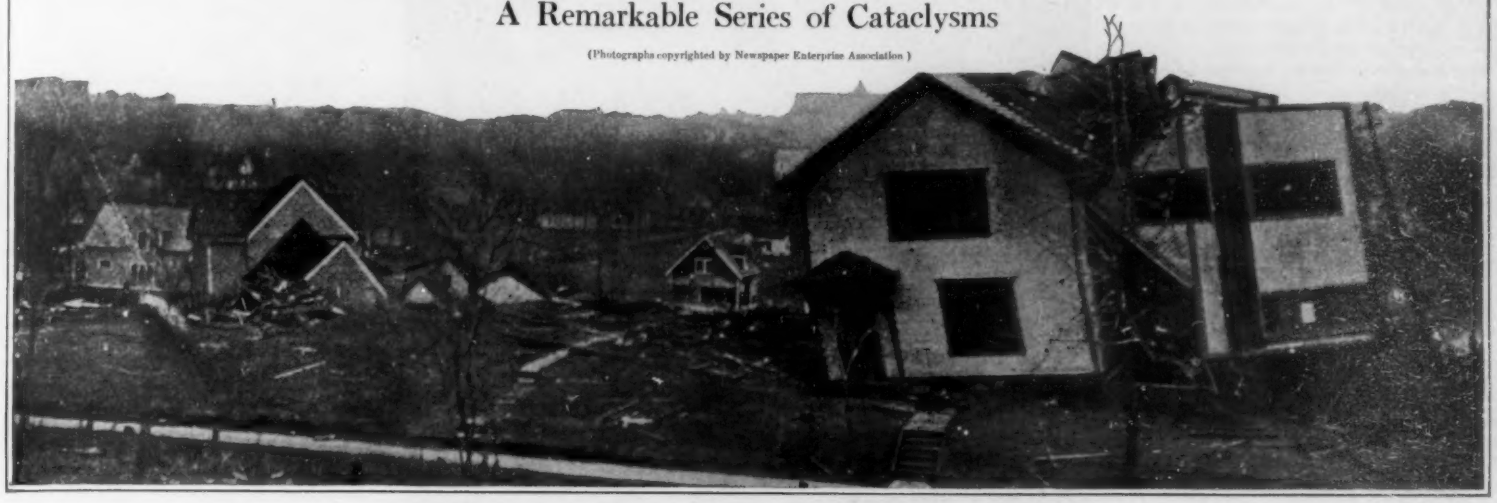
Night Plowing

A NOVEL departure is reported to have been made in New South Wales by starting plowing at night. For this purpose two powerful acetylene headlights are attached to the traction engine which draws the plows, and the ground is so well and brilliantly lighted that the operator can work over the field quite as well as by daylight. Departures of this character frequently lead to many improvements in the application, operation and adjustment of the lights.

The Recent Storms and Floods

A Remarkable Series of Cataclysms

(Photographs copyrighted by Newspaper Enterprise Association)



One house blown against another. A curious result of the tornado's power.

THE storms and floods of the latter part of March, 1913, will rank among the greatest meteorological disasters in the history of this country. It is too soon to attempt a detailed analysis of these occurrences, from either a theoretical or a practical point of view, since up to the present writing both Weather Bureau reports and press dispatches from the stricken district are much curtailed by the interruption of telegraphic and other means of communication. The salient facts, however, may be stated as follows:

On Sunday morning, March 23, a well-defined and symmetrical cyclonic disturbance overlay the western half of the United States, with its center over Colorado. The winds were everywhere moderate, and, above all, the cyclone did not exhibit any of the characteristics regarded by weather forecasters as harbingers of tornadoes. The morning weather map of that date shows none of the distortion of the isobars into a V-shape that indicates a tendency to line-squalls. At 8 P. M. (Eastern time) the storm had moved into a direction and at a rate that was in no way abnormal, and was central near Omaha. The isobars were still symmetrical. For some reason that is hardly apparent from the weather maps, violent thunderstorms and scattered tornadoes occurred Sunday afternoon and evening over a broad zone on the right side of the cyclone's path. It is especially remarkable that a tornado occurred at Omaha, almost at the very center of the cyclone, at about 6 P. M. local time. As a rule, tornadoes develop several hundred miles southeast of a cyclonic center.

From the fragmentary information now at hand, it appears that the tornadoes which occurred in Nebraska, Iowa, Illinois, Indiana, Michigan, and Wisconsin occasioned an aggregate loss of about 240 lives, that some 700 people were injured, and that $5,000,000 worth of property was destroyed. Much the heaviest losses occurred at Omaha, but this does not mean necessarily that the winds were more violent at that point than anywhere else; the area of devastation in a tornado is always small, and the amount of damage done in a populous city is, of course, much greater than in small towns or the open country.

In their destructiveness the tornadoes of March 23rd were among the worst this country has ever experienced. In the number of fatalities by which they were attended they have probably been surpassed only by the tornadoes of May 24th to 27th, 1896, which included the terrible St. Louis tornado of May 27th. The latter, though not relatively severe, passed through a great city and destroyed 306 lives, besides damaging property to the value of nearly thirteen million dollars.

The cyclone that occasioned the recent disasters passed into eastern Canada on Monday and rapidly left the continent. In the meantime a long trough of low barometric pressure spread up from the southwest, and by the morning of March 25th its axis extended along the whole length of the Ohio Valley. It was attended by heavy rains, especially over the northern watershed of the Ohio, where equally heavy rains had occurred on Sunday and Monday in connection with the previous depression. This continuous downpour turned the northern tributaries of the Ohio into raging torrents, and on the 25th the southern valleys of Ohio and Indiana were submerged. The conditions were unprecedented. Previous great floods of the Ohio Valley have generally been due to the main river overflowing its banks; under those circumstances, the antecedent conditions usually give ample warning of what is to happen, and the progress of the flood-crest down the stream is relatively slow. In the present case, a huge freshet occurred suddenly in the whole complex of smaller streams on the northern watershed, where the elaborate system of river-gages and rainfall stations, which make flood prediction in the main rivers an easy task, was of no avail.

On the 26th the rainfall area spread over the southern watershed of the Ohio, and the enormous contributions of water from both sides soon raised that river above flood stage. The colossal disasters, however, which will make the floods of March, 1913, historic were those which came unheralded on the 25th along the northern tributaries of the Ohio. The details are still fresh in the public mind, and need not be recapitulated here. By the 27th the cyclonic area had passed east to the Atlantic seaboard, and was followed by a rapid fall in temperature over the flooded region, greatly adding to the suffering of the homeless people. The storms and floods had paralyzed the railways and the telephone and telegraph lines, so that the work of rescue, in which the whole nation co-operated, was greatly hampered.

A practical consideration in connection with this appalling flood is that, though it is altogether unprecedented in magnitude, in the history of the region concerned, it may be equaled or even surpassed in the future, unless some rational measures are taken to control the headwaters of our great rivers.

Automobiles were blown down from a viaduct.

A resident of Omaha collecting his belongings after the tornado.

An Improvement in Electro Deposition.—A patent has been granted to Stefano Consigliere of Genoa, Italy, for a process and apparatus relating to the electro deposition of metals and wherein a multiplicity of loose, small, relatively heavy bodies are arranged in the receptacle for electrolyte and which will operate to beat and roll upon the coating deposited in order to render it more compact and resistant.

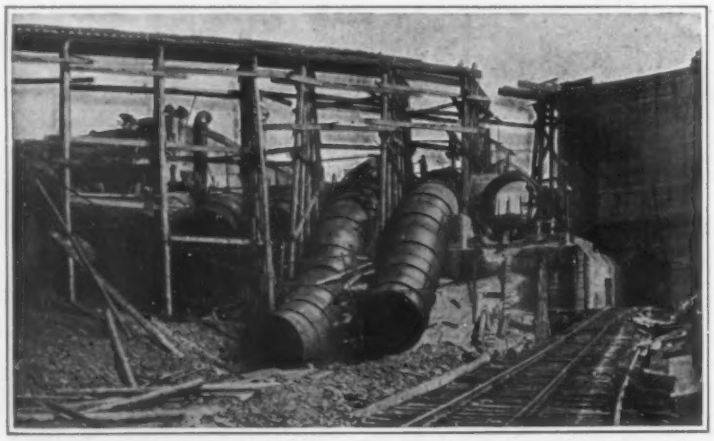
A Cascade of Stone

A REMARKABLE calcareous formation is to be found in Algeria about sixty miles from Constantine, the ancient Cirta. It looks like a magnificent cascade with the water in violent motion pouring over a rocky cliff in turbulent and riotous confusion, and yet the cascade is as motionless and silent as the photograph reproduced herewith. It is as though a great waterfall had suddenly turned to stone. Naturally the natives look upon this phenomenon with great awe. They have given it the name Hamman-Meskhutin, which means "the bath of the damned." They have a legend that the waterfall was turned to stone together with the members of an impious tribe who had incurred the wrath of Allah. At night these petrified individuals, according to the story, are restored to life and resume their normal shapes. The petrified waterfall has been produced by calcareous deposits from hot sulphurous and ferruginous mineral springs. The springs have a temperature of 95 deg. Cent. The deposits have, of course, been making for many centuries. The hot springs were known to the ancient Romans. We are indebted to the *Illustrated London News* for these facts and for the accompanying photograph.

The petrified cascade of Hamman-Meskhutin, Algeria.

Head Cooling Apparatus

THE man pictured in the accompanying photograph is not a hot-headed individual undergoing treatment to allay his angry passions, as one might suppose upon reading the caption. He is merely wearing a cooling coil designed by a Vienna doctor as a physical aid to medical treatment. Modern advances in therapeutics have scientifically established and widely extended the utility of thermal methods of treatment. Innumerable cases might be instanced, says the inventor, in which in one form or another the application of heating or cooling agents to certain parts of the body constitutes the most effective remedy that is at the disposal of the physician and surgeon. Pain may in the majority of cases be alleviated or even entirely suppressed by the judicious application of heat or cold. Usually ice bags are used for this purpose. But the patient has to endure the weight of the bag with its load of ice and ice-water. Whereas in the construction here shown, all the weight he carries is the small coil of tubing, which is quite flexible and easily fitted to the head. The supply of ice-water is siphoned down through the tubing from an elevated reservoir and is slowly discharged into a receptacle. The rate of flow is governed by a suitable valve on the discharge pipe. The tube is of rubber, wound with aluminium wire, so that it is extremely flexible and will maintain any set position. Similar cooling devices are provided for other parts of the body.



The conduits of the hydro-electric power plant at Gatun for operating the Panama Canal.

A head cooling apparatus.

Mounting a giant sunfish.

Combined Ambulance and Patrol Wagon

THE city of Dayton, O., which, like several other large cities in the United States where the manufacture of automobiles centers, rapidly is replacing horse-drawn municipal vehicles with more modern and more efficient automobiles, recently has taken delivery of an unusual type of combined ambulance and patrol wagon which has several interesting constructional features. It is shown by the accompanying illustration, the photograph having been taken during a demonstration of the vehicle's adaptability to the city's needs.

When the vehicle is used as a patrol wagon, the light canvas stretchers which serve for ambulance service are carried on large hooks up near the roof; one of them can be seen in the picture. Otherwise, which means when they are in use to convey injured persons to the hospital, they are carried in spring supports, the center ones folding down out of the way when the side seats are folded up for the sterner duty of the police force. As it often is necessary for the surgeon to get at the head of his patients as they lie in the stretchers, a forward side entrance is provided. As a patrol wagon, the capacity of the vehicle is a "squad," or eight men, not counting the driver's seat and the one beside it. When occasion demands, the seats on only one side can be let down and one of the stretchers placed in position on its swinging supports.

Dayton, Ohio, police patrol wagon converted into an ambulance.

Street car ambulance for Bahia, Brazil.

Conduits for the Hydro-electric Plant at Gatun Dam

THE Panama Canal is to be electrically operated and lighted throughout by power which will be generated at a hydro-electric plant located at the spillway to the Gatun Dam. At present two steam-electric stations exist, one at Gatun and the other at Miraflores, each consisting of three 1,500 K.V.A., 3-phase, 25-cycle, 200-volt steam turbo-driven generators. The power station at Miraflores will be retained permanently as a substitute or auxiliary station in case of breakdown or other emergency; but a new power station now being built at Gatun will be of sufficient capacity to furnish the necessary power for the whole canal. The hydraulic plant will consist of three 2,500 K.V.A., 3-phase, 25-cycle, 220-volt water-wheel driven units with sufficient provision for three additional units. The power will be utilized in the operation of the electric towing locomotives which will haul ships through the various locks, operating the lock gates, and lighting the whole canal. Ultimately, part of the power of this plant will be used for the electric operation of the Panama Canal Railroad. The illustration herewith presented shows the conduits through which the surplus waters of the lake that are turned through the plant will be conducted.

A Two Thousand-Pound Sunfish

ONE of the largest and most astonishing marine wonders seen for some time has recently been brought to light from ocean depths. This is a remarkable specimen of a giant sunfish, shown in the accompanying photograph. This huge monster measures 10½ feet from tip to tip of his fins and is 9 feet long; it weighs nearly 2,000 pounds. The great fish was captured in the Pacific Ocean off the California coast, and the skin has just been mounted in New York for museum exhibition. The tremendous size of this denizen of the deep can be seen from the figure of the man standing near the head. Such huge monsters are rare, however, though some weighing from five hundred to eight hundred pounds have been obtained occasionally. They are to be seen in tropical and temperate seas, both in America and other countries. While inhabiting the open sea, at great depths, they are frequently to be seen off the California and Florida coasts. The skin has a brilliant silvery appearance and at night is said to be highly phosphorescent. The flesh, however, is not used for food. The big fish has comparatively a small mouth, and to provide for the enormous stomach consumes thousands of small fish and various other marine creatures. The great fins are three feet long, and when swimming the upper one protrudes high out of the water. From certain ridges and folds developed on the body it is thought the monster is about fifty years old. One of the striking features, next to the colossal size, is the peculiar shape of the body, which looks as if the hind portion had been bitten off by some other formidable ocean inhabitant and left only a fringe of a tail.

Street Car Ambulance

AMBULANCES of all kinds and descriptions have been in use for many years past, but not until the present time has there been manufactured a conveyance for the transportation of hospital pa-

(Concluded on page 324.)

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Preparing for the Post-fuel Age

ALTHOUGH coal was mined in Newcastle as early as the thirteenth century, it is only during the past hundred years or so that any very heavy drain has been made on our fuel stores, and already, despite the shortness of the period, we have found that they are not limitless, but are fast being exhausted. No matter how economical we may be, all our coal stores will eventually be consumed, and then we shall have to return to the powers in use long before the steam age. Already we are making extensive use of water power or "white coal" as it is called, and determined efforts are being made to produce electrical energy from wind power. The tide has yielded us some power and so have the waves, and a considerable measure of success has attended the experiments with the production of power directly from the sun, which by the way, is the source of the power in our coal, our rivers, the wind, the waves, and to a large extent, the tide.

It is interesting to see what inventors have been doing toward the engines of the future. Herewith are a few typical cases picked out at random from hundreds of patents. We have selected no water power engine or motor for the reason that hydraulic power may be considered well past the experimental stage. One would suppose that wind power would also be in this class. Quite apart from the problem of storing the energy there has been much inventive activity in the design of the wind wheel itself. One of the principal objects appears to be to provide automatic means for reefing the wind wheel sails so as to prevent wrecking of the machine in a storm. Another object is to design the wheel so that it does not have to turn or swing into the wind, but will operate with equal efficiency with the wind blowing upon it from any direction, although the wheel itself revolves on a fixed axis. Such a wind wheel is shown in Fig. 1. The wheel is in the form of a vertical drum so that it will be revolved by wind from any point of the compass. To assist the vertical drum a pair of turbines are mounted on a horizontal axis above the main drum, and these are connected with a vane in the usual way to bring them into the wind. Fig. 2 shows a very ambitious design. The wind wheel is of mammoth size and provided with a huge disk vane to direct it into the wind. The entire structure is mounted to rotate on a turntable.

The motor shown in Fig. 3 is adapted to be operated by the tide. It will be observed that as the float is lifted from the position shown in full line to that shown by dotted lines, a pair of toothed sectors will be moved in opposite directions as indicated by the arrows and acting upon pinions will transmit power to a power shaft. In considering this invention it is well to refer to a problem sometimes given to first year men in Stevens Institute. The problem is to figure out the amount of work done by the tide in raising a giant ocean liner from ebb to flood tide. Take a huge vessel say nine hundred feet long and ninety-five feet beam, weighing 50,000 tons. In New York the tide rises about four and one half feet. One might suppose that it would take an enormous power to raise such a craft as this. But one is apt to overlook the time element. It takes the tide six hours to do the work, so that it actually exerts less than 38 horse-power.

Inventors are apt to forget the amount of surface the float must cover in order to give them a power that is commercially worth while. And yet it is possible to use the tide commercially; in fact it has been used for a long time in certain favorable locations. The prime requisite is a large reservoir into which the rising tide can flow and a narrow passage for the water. Power may then be obtained from current wheels placed in the stream of water. Fig. 4 illustrates a tide mill located in such a favorable position. On one side of the mill is the reservoir, on the other the open water. Owing to the difference of level on opposite sides of the mill, the water will flow in the direction of the arrow against an undershot wheel, thus producing rotary motion. Gates are operated to reverse the conditions when the tide turns. The water will then flow in the opposite direction and operate a second undershot wheel. Of course with a system of this sort there must be long periods when no power is generated because there is practically no difference of head in the water on opposite sides of the mill. The tide motor has the advantage that it can be placed in a protected bay, and hence is not subject to destruction by storm as are the ordinary wave motors.

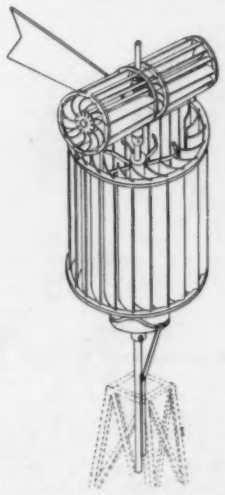


Fig. 1.—Wind wheel that turns on a vertical axis.

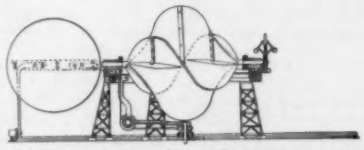


Fig. 2.—Mammoth wind motor mounted on a turntable.

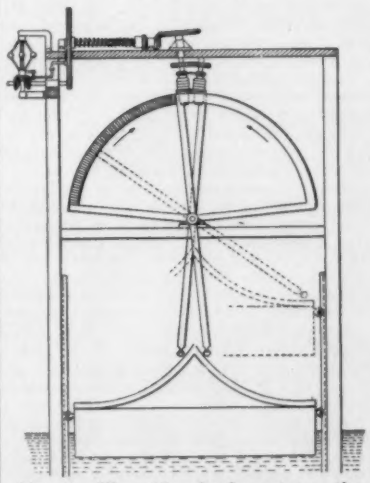


Fig. 3.—The tide slowly rotates the sector driving the power shaft.

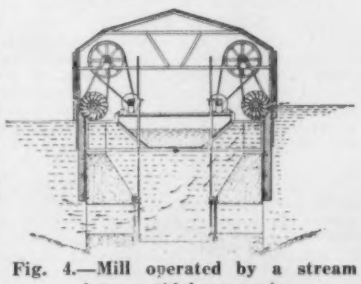


Fig. 4.—Mill operated by a stream from a tidal reservoir.

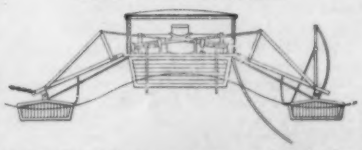


Fig. 5.—Wave motor operated by oscillating floats.

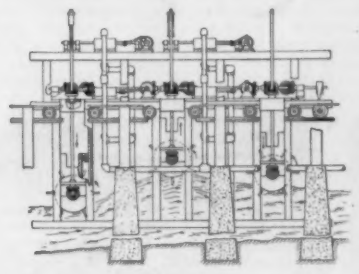


Fig. 6.—Paddle wheels propelled by the surf.

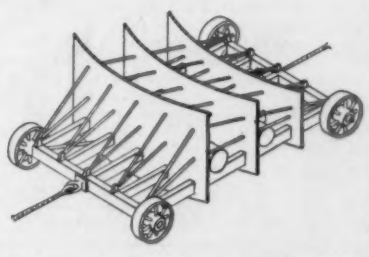


Fig. 7.—A "surf wagon" that operates a compressed air system.

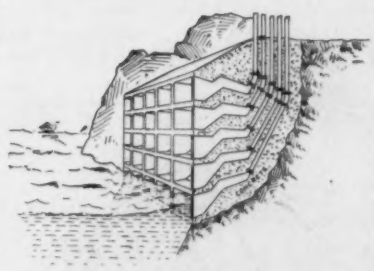


Fig. 8.—Surf dashing into the cells drives compressed air into a reservoir.

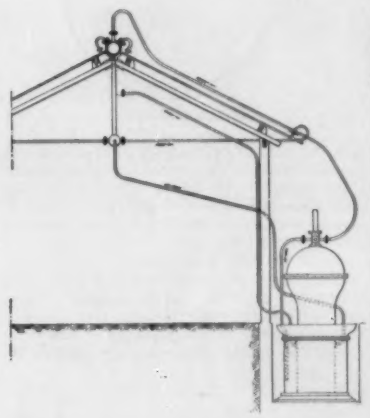


Fig. 9.—Utilizing a sun-backed roof to generate power.

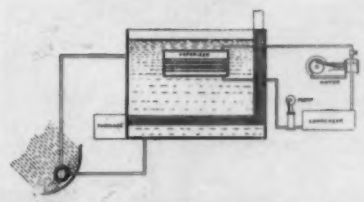


Fig. 10.—Combined sun and fuel heated boiler for an ammonia engine.

Fig. 5 shows a wave motor which may be anchored out at sea, and which will communicate power by electric cables to land. It consists of a series of floats connected by rocking arms. The heaving of the waves causes the floats to move up and down with respect to one another, rocking the arms to which pump pistons are connected; and so, as the floats are rocked, the pistons operate to pump water or air into a reservoir. If the reservoir is filled with air it may by means of a compressed air motor drive a dynamo which will generate current that may be sent to land through a cable, where the power may be utilized in any desired way.

Most of the wave motors, so-called, are really surf motors; that is, they depend upon an actual horizontal travel of the water. Quite an elaborate surf motor is shown in Fig. 6. It consists of a series of paddle wheels mounted on floats so that they will rise and fall with the waves and keep the paddles constantly submerged to a predetermined depth. Then as the waves rush back and forth, they will cause the paddle wheels to revolve, producing rotary motion which is communicated through suitable gearing to air pumps. Another type of surf motor is shown in Fig. 7. It consists of a series of large vanes or plates mounted on a low broad-wheeled vehicle and arranged to be driven by the surf up the beach. Cables are attached to the vehicle connecting it with suitable mechanism on land. One of the cables, however, passes around a pulley anchored out in the water. When the vehicle is driven up the beach it raises a weight which assists in carrying the vehicle back with the receding waves. This reciprocating motion of the vehicle operates an air pump that stores the energy in a compressed air reservoir.

Another scheme for utilizing the power of the surf is shown in Fig. 8. It is adapted to be built along a rocky coast. It consists of a many-celled concrete structure, firmly anchored in the rocks. As the waves dash into the open cells they compress the air contained therein and force it through pipes to a reservoir. Automatic valves on the pipes prevent the return of the air from the reservoir into the cells.

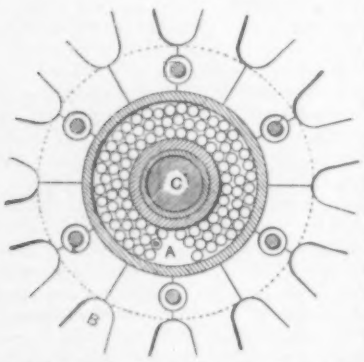
Although the heat of the sun has been utilized to raise water to the boiling point and operate low-pressure steam engines, some inventors have thought it better to utilize a fluid that is more readily vaporized than is water. The apparatus shown in Fig. 9 employs an ammoniacal solution which is vaporized by the heat of the sun beating upon the roof of a building. This vapor is automatically condensed by means of cold water after passing through the engine, and then is returned to the roof to be vaporized again. Thus a closed cycle is maintained converting the heat of the sun into power. A similar apparatus for utilizing solar heat is shown in Fig. 10. Instead of applying the heat of the sun directly upon motor fluid it is concentrated by a reflector upon a body of water which will be suitably heated, thereby filling a reservoir with water, warm enough to vaporize the fluid used in the pump or motor system. This apparatus employs in addition to the solar water heater, a furnace which may be used on dull and cloudy days when the

solar rays do not yield sufficient energy to operate the apparatus. In this system as in the one just described a suitable condenser is required to restore the motive fluid to liquid form after which it is pumped back into the vaporizer to be converted into a gas that will operate on the motor.

Shock-absorbing Hub

FOR over two years motor 'buses have been in use in London, which run on leather tired wheels, and the vehicles are said actually to run with less vibration than pneumatically tired omnibuses.

The secret lies not in the tire, although it is of novel form, being made of hydraulically compressed, specially tanned leather, but in the hub, which is so designed as to dissipate the shocks before they reach the axle. The hub is shown in the accompanying cross-sectional view. It will be observed that an annular space between the shaft and the hub cylinder is filled with steel balls, each about ⅜ inch in diameter. These balls go around the shaft and support it. They do not quite fill the annular space, but leave a gap, such as indicated at *A* under the axle *C*. The balls arrange themselves in an arch across this gap. A road shock passing up one of the spokes *B*, of the wheel cannot reach the axle, because of the row of balls *D* intervening. The entire row is forced across the gap *A*, carrying the momentum of the shock from the forward to



Steel ball fluid bearing for automobile wheels.

the backward moving half of the wheel. The shock is then communicated to the steel balls above, which slip and slide upon each other and revolve on their axes, distributing the shock just as a liquid would. In fact the filling about the axle may actually be considered a steel ball liquid so far as its operation is concerned, but with the advantage that the steel balls are slightly elastic.

The inventor of this shock-absorbing hub is John Muir. The hub has proven very satisfactory, and the use of solid leather tires, which it permits, has resulted in material saving over the previous use of pneumatic rubber tires.

A Comparison of Patent Office Salaries.—The salaries paid the officials of our Patent Office suffer when contrasted with those paid by Great Britain, for notwithstanding the much higher cost of living in Washington over that in London, the salaries are much lower than abroad. Our Commissioner receives $5,000 per year while the British Comptroller enjoys an income of $7,500 or 50 per cent more. Here the Assistant Commissioner receives $4,500 while in England the chief examiner receives $6,000. Our chief clerk has a salary of $3,000 while the British chief clerk has a salary of $5,000 per year. We have three Examiners in Chief at $4,000 each while the four supervising British examiners have a salary of $4,100 each. Our forty-three principal examiners have $2,700 per annum while $3,400 is paid each of the thirty principal examiners of the English office. While our Examiner of trade-mark has a salary of $2,700 that of the registrar of trade-marks in the British Office is $5,500 or more than double the amount paid the corresponding official here.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

SWITCH AND RECEPTACLE BOX.—E. ROSENKRANZ, 201 Third Ave., Manhattan, N. Y., N. Y. This invention has reference to a switch and receptacle box designed to be supported in a recess in the wall or ceiling of a building, and having openings in the side closed by plates which receive and secure the ends of the cables or other conductors with which the building is wired.

Of Interest to Farmers.

WING CARRIER.—W. F. BROWN, 5207 Penn Ave. So., Minneapolis, Minn. The carrier employs troughs and conveyer means mounted therein and moved lengthwise thereof for impelling the material deposited in the trough to the delivery end thereof. In the construction the sides of the trough are disposed at various angles to contract or expand the carrier. Means provide for raising and lowering the delivery end of the trough.

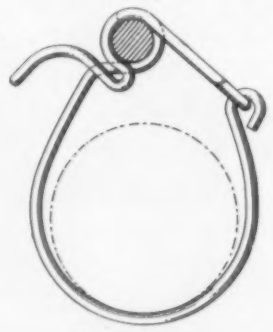
AUTOMOBILE CULTIVATOR WITH ROTATIVELY-DRIVEN CULTIVATING DISKS.—M. LANDRIN, Place Mantoue, Soissons, Aisne, France. The cultivator frame is connected to the tractor frame by a universal pivot device, in order to allow the tractor to oscillate in accordance with the irregularities of the ground without affecting the working position of the cultivator frame. The shaft carrying the cultivator disks is adjustable in direction in relation to the line of travel.

Of General Interest.

STAIR TREAD ANCHOR.—H. H. VERITY, 1441 Chester Ave., Ozone Park, L. I., N. Y., and J. HANSON, Corona, Queens, N. Y., N. Y. This invention relates to concrete stairways, and its object is to provide a new and improved stair tread anchor adapted to be embedded in the concrete steps, and arranged to allow of conveniently and securely fastening the stair treads in position or removing the same in case one is worn out.

FOUNTAIN PEN.—G. W. HEATH, 232 Second St., Newark, N. J. An object here is to eliminate the possibility of accidentally collapsing the reservoir tube, and, at the same time, to provide a construction in which the presser bar is raised out of engagement with the flexible reservoir before the device can be set in its normal position and which is positively locked in this raised position.

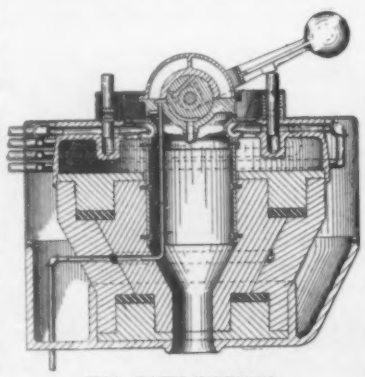
CABLE HANGER.—C. LINGLE, Clinton, Mo. Among the principal objects which the present invention has in view are: to provide a simple and efficient device to facilitate the hanging of electrical and other cables; and to provide means, incorporated in the construc-



CABLE HANGER.

tion, for increasing the grip of the device on the messenger or supporting line proportionate to the weight of the cable. The accompanying illustration shows the hanger in its final or normal engaged relation with the messenger wire.

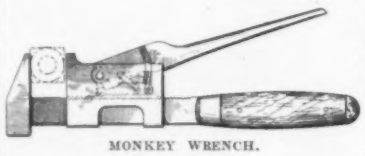
SODA WATER FOUNTAIN.—A. H. STEIN, Jacksonville, Fla. The invention provides a soda-water fountain having means whereby the carbonated water supply may be controlled, together with a plurality of means for controlling each of the sources of syrup, the construction and arrangement being such that the carbonated water may be supplied in a fine stream at the same time that the syrup is supplied, thereby mixing these substances within the glass or in supplying the syrup with the carbonated water in a heavy stream.



SODA WATER FOUNTAIN.

Hardware and Tools.

MONKEY WRENCH.—J. KRAHULEC, Lock Box 134, Braidwood, Ill. In the present patent the invention is an improvement in that class of monkey wrenches which are provided with a slidable jaw and a toothed dog adapted



MONKEY WRENCH.

to engage a toothed portion of the wrench shank, for locking the said jaw in any desired adjustment relative to the fixed jaw. The improvement is adapted to serve as an ordinary monkey wrench or as a pipe wrench, as occasion requires.

Heating and Lighting.

FLUE SECTION.—W. D. IVES, 244 York St., Jersey City, N. J., and J. NOVAK, N. Y., N. Y. This invention provides a section having heating pockets for admission of air to the fire-pot of a furnace; provides a section constructed and arranged in knock-down form, adapted to be varied in size to suit exigencies of installation; provides means adjustable in conjunction with a flue damper, for varying the proportion of fresh air admitted; and provides air-ducts the length of which may be varied to suit the exigencies of installation.

Household Utilities.

PORTABLE RECEPTACLE OR CONTAINER.—B. NADEAU, Presque Isle, Maine. This improvement pertains to containers, and more particularly for embodiment in a coal scuttle or hod. The object of the invention is to provide a container that can be easily and readily filled without the use of a shovel, by forcing the mouth and neck of the container into a pile of material.

FLY KILLER.—E. L. GRIMES and F. PETERSON, Red Cloud, Neb. Among the objects aimed at in this invention are the following; to provide a poisoning device that is simple in construction and operation, cheap to install and use, and which may be disposed out of the way of children or household pets, and to provide a device which is certain in its operation to destroy the flies.

Machines and Mechanical Devices.

ENGINE STARTER.—G. J. SPOHRER, care of Wilson Motor Starter Co., Franklin, Pa. This invention relates to an engine starter, and an object of the inventor is to provide a form of device in which a fluid-actuating element is positively brought into engagement with the engine mechanism after a back firing action on the part of the latter.

CURRENT MOTOR.—J. H. MARTIN, 615 W. Lynne St., Springfield, Mo. This invention provides a motor of an improved form of vane, which will automatically take a position at right angles to the direction of movement of the current when the vane is in the water, and a position parallel with the direction of movement of the vane when out of the water, and wherein the change in position of the vane is caused by action of the water, and wherein no extraneous mechanism is necessary for making the change in position.

MECHANICAL MOVEMENT.—J. W. PITTS, 3635 Tenth St., N. W., Washington, D. C. An object here is to provide a device whereby a reciprocatory motion may be converted into a rotary motion or *vice versa*. A mechanical movement is provided in which there is less loss of power in the conversion of one motion into another and into the ordinary mechanical movements.

AUTOMATIC HOSE AND FABRIC CUTTING ATTACHMENT FOR KNITTING MACHINES.—T. RYAN, care of the Simons & Struve Hosiery, Frankford, Philadelphia, Pa. In this invention the attachment comprises cutting mechanism, preferably in the form of scissors or shears, which is automatically operated to sever rib hose or other fabric as produced by a knitting machine, thus dividing the product into desired lengths or sections.

VALVE CONTROLLING MECHANISM.—J. L. EDLAND, Bloomfield, N. J., care of H. J. Koehler, 33 So. Munn Ave., East Orange, N. J. This invention relates to certain improvements in valve-controlling mechanism, and the purpose of the improvement is to so control a plurality of valves that they may operate independently, yet in their operation will permit the passage of equal amounts of fluid.

ALARM BANK.—C. SAYERS, 121 Lexington Ave., Jersey City, N. J. The invention is an alarm bank adapted to be secured upon a shelf or other support by a suitable fastening device such as a bolt or screw. The fastening device is connected to mechanism on the inside of the bank casing by means of which an alarm will be sounded when the bank is removed from its proper place, the fastening device exerting a tension upon the alarm mechanism and actuating the same to produce the effect.

SORTING MACHINE.—C. W. NARAMOR, Mecosta, Mich. This invention relates generally to sorting machines and more particularly it is directed to one particularly adapted to sort beans. The principal object is to provide a new means of adjustably mounting disks on a rotatable shaft, the construction being particularly adapted for use in bean sorting machines.

BAND MILL LINING DEVICE.—J. E. WHITWORTH, L. B. 90, Jeanerette, La. This invention relates to means or appliances for setting band mills or the like in sawmills and has particular reference to an implement comprising a frame or support track and also including a plumb line which is adapted to cooperate in the setting of the mill with one or both of the band-wheel shafts.

DEVICE FOR AFFIXING AND PRINTING ON LABELS.—S. BYLICKI and J. PARENSKI, Kracow, Austria-Hungary. The labels, stamps or the like form a continuous strip, which is wound into a roll or zigzag folded. By a single operation of a handle the foremost label or stamp already separated from the rest is fed forward, moistened or coated with a suitable adhesive, affixed and provided with an impression at a predetermined point and the next label or stamp is drawn forward and separated from the rest so that the device is ready for the next operation.

Prime Movers and Their Accessories.

ENGINE VALVE.—W. JOHNSON, P. O. Box 32, University Place, Neb. The object of the invention is an improvement in rotary and oscillating engine valves, air compressor valves, ammonia compressor valves, throttle valves, cut-off valves, admission and releasing valves. A casing and cone valves are employed having diametrically opposite ports, gearing for rotating the valves in a particular manner, and boxing adapted to adjust the valves endwise.

Railways and Their Accessories.

CAR VENTILATOR.—W. L. WALSH, 424 E. 157th St., New York, N. Y. This invention provides a flue from which the air may be drawn by operation of the train and devices to govern the communication between the interior of the car and the flue; provides auxiliary boxes having communication with the interior through controlled passages, the air in the chambers being exhausted by the travel of the car; provides means operable from within the car for varying the disposition of the draft members of the ventilator; and provides draft members for flue and boxes extended beyond the influence of eddying currents formed by the movement of the car body.

Pertaining to Recreation.

GAME APPARATUS.—J. B. FORTNAM, 1465 Bushwick Ave., Brooklyn, N. Y. This invention provides a game apparatus with which may be played several interesting games, the game apparatus consisting of a board with a group of forty-one hexagonal spaces, there being a star in the space in the center of the board, and marks to indicate the castles which are spaced apart on each side of the board.

Pertaining to Vehicles.

BICYCLE PUMP.—E. B. WRIGHT, Box 355, St. Helena, Cal. This invention has reference to improvements in bicycle pumps, and has for an object to provide an improved pump and supporting devices adapted to hold the pump for fitting in a proper position on the bicycle frame for ready operation at all times.

Designs.

DESIGN FOR A MEMBER OF A PAIR OF SHEARS.—W. M. BOWES, 127 Duane St., New York, N. Y. In this ornamental design for a member of a pair of shears, the member presents a graceful design in which some of the usual round features are outlined by angles.

DESIGN FOR A DISH.—M. HERBERT, 26 Murray St., New York, N. Y. In this ornamental design for a dish the designer shows a cut-glass dish in the form of an automobile.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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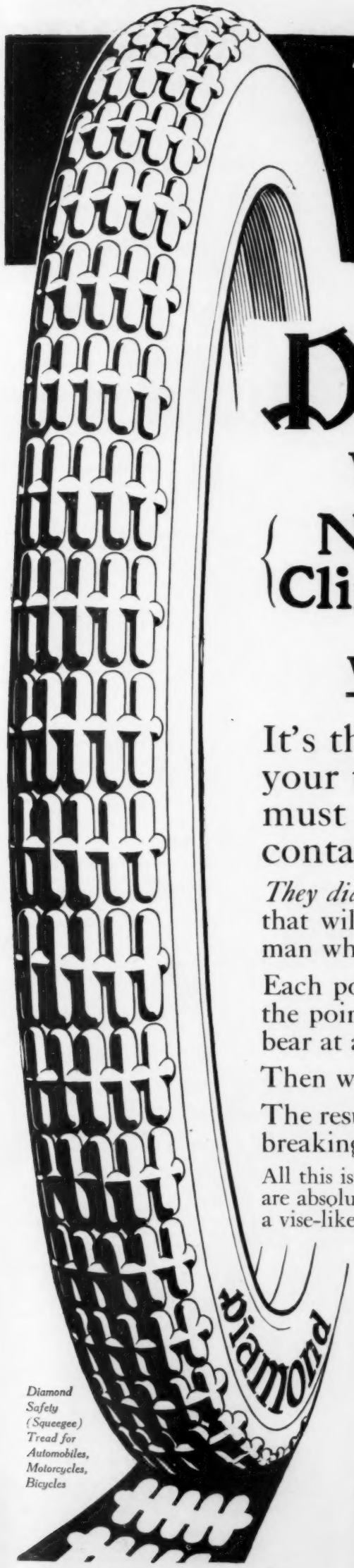

Diamond Safety (Squeegee) Tread for Automobiles, Motorcycles, Bicycles

Tire bill payers!

You have demanded a vise-like rim-grip - with no cutting or breaking above the rim-and here it is

Diamond

Vitalized Rubber

{No Clinch} Tires

Cross Section Diamond Safety Tread Tire

with Perfect 3-Point Rim Contact

It's the *rim* as much as the *road* that wears out your tires. So we said to our engineers: "You must build us a tire with perfect 3-point rim contact."

They did—and now we offer you a sane, sensible, No-Clinch tire that will appeal to you, as a hard-headed, shrewd tire buyer—a man who insists on easy riding comfort and good liberal mileage.

Each point of rim contact in a tire is a point of support. Where the points of contact are not perfect, undue pressure is brought to bear at an unsupported point of the tire.

Then what happens?

The result is a terrific strain on the tire that will cause rim troubles, breaking above the bead and separation of the tread from the carcass.

All this is overcome in the "Diamond" because the three points of rim contact are absolutely *mechanically perfect*—the annealed steel cabled wire bead holds with a vise-like rim-grip.

This is only one Diamond advantage.

You get additional More Mileage without extra expense in the Diamond *Vitalized Rubber*—a scientific combination of pure, lusty, young rubber and a secret toughening compound—nothing inferior in rubber, fabric or workmanship—the No-Pinch Safety Flap inner tube protector—and, if you desire, the now famous Safety (Squeegee) Tread.

So this time buy Diamond Vitalized Rubber Tires—you can get them to fit your rims at any of the

25,000 Diamond Dealers
always at your Service

The guarantee on Diamond Tires becomes null and void when the tire is used in connection with any substitute for air, fitted to rims not bearing one of these inspection stamps or having had its serial number removed in whole or part

River Parkway, Cambridge, Mass.

Cambridge's Experience With Tarvia

CAMBRIDGE, MASS., is another Tarvia town. Many of its roads have been built during the last five years with "Tarvia X" or treated with "Tarvia B." The streets of Cambridge carry an enormous automobile traffic, and the problem of maintaining adequate road surfaces was a serious one.

During 1912 eight of the leading thoroughfares which had been built with "Tarvia X" received surface treatment with "Tarvia B" at a cost of 2¾c. per square yard.

The Superintendent of Streets of Cambridge reports: "This treatment not only preserves the surface of the road from raveling, but renders the street dustless to a large extent. It has been found to be the most economical way to care for tarbound macadam."

In later years it will be found that additional annual treatments with "Tarvia B" will cost less each year. Westfield, N. J., for instance, found that roads which had been built with Tarvia cost as little as 1¾c. per yard per year to maintain with "Tarvia B."

Towns which experiment with Tarvia get the habit and in time settle down to its use as a matter of consistent policy. By this means they reduce their road costs and at the same time give greater satisfaction to the citizens.

Tarvia is a special combination of refined tars especially prepared for road use. It forms a tough, plastic matrix about the stone and prevents erosion and attrition. It is not a palliative but a cure. It does not *suppress* dust so much as prevent the attrition which *creates* dust. Booklet on request.

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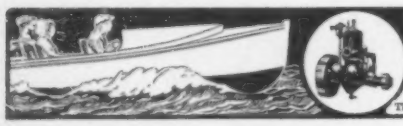
TRADE B MARK



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3 H.P. 1 cyl.	$ 65.00
6 H.P. 1 cyl.	84.00
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12 H.P. 2 cyl.	160.00
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In *Scientific American Supplements*, 1641 and 1642, E. F. Lake describes simply and thoroughly how a five horse power gas engine can be built at home. Complete working drawings are published, with exact dimensions of each part. ¶ Price by mail for the two Supplements, Twenty Cents. :: :: :: :: ¶ Order from your newsdealer or from

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Our recent advertisements in Scientific American, Special Numbers, tell you what is the opinion of well-known experts about **Electrene, The Fire Gun.** Yacht and Motor boat builders, and the Engineering Departments of many of the largest factories and transportation systems are discarding old style extinguishers in favor of Electrene. The New York Fire Department ordered a trial lot a year ago. After careful tests they ordered in quantity. Recently they have repeated with a further quantity order.

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Electrene resting on cup and held by Clamp

Simply turn the Nozzle

ELECTRENE COMPANY

Whitehall Building New York City

Notes for Inventors

Timer for Electric Welding Machines.—John Allen Heany of Washington, D. C., in patent, No. 1,050,827, describes an electric welding machine, which embodies a transformer and electrodes and means automatically operated from the line circuit for stopping the welding action at a predetermined time so that the period of welding operation may be controlled.

Parcel Post Improvement.—The inauguration of the parcel post service promises to lead to various improvements in equipment and accessories; racks in receiving and delivering stations and in the cars, packages or cartons especially adapted for the receipt of the commodities, and ready reckoners for rates, and the improvements will no doubt lead in many other directions as the ingenuity of the inventive class is brought to bear upon the demands of the service.

An Edison Phonograph Patent.—Thomas A. Edison, assignor to Thomas A. Edison, Incorporated, has patented, No. 1,050,355, a phonograph in which the sound-conveying horn is directed forwardly from a reproducer in approximately a horizontal direction, the chambers containing the horn and reproducer being separated and the motor being located below the reproducer chamber. The structure is of a pleasing appearance and permits the suspension of the sound-conveying means in a horizontal position so that the loss of volume due to bends in the horn is prevented, while at the same time the advantages of the concealed horn are retained.

Timber-cutting Method.—Patent, No. 1,050,768, for method of severing timber, has issued to Hugo Gante of Berlin, Germany, for a method in which one or more wires are reciprocated against a timber producing the heat necessary for the carbonization of the timber in front of the wire, the wire being preferably provided with projections to aid in producing the heat. The patent distinguishes from the known method of severing timber by means of specially heated wires as in the improved method there is used solely the heat which results from the friction between the wire and the timber, the toothed or roughened feature of the wire aiding in scraping away the resulting carbon.

A New Gold-leaf Process.—What is said to be a new process for the manufacture of gold leaf has been introduced by a London firm. In carrying out the process, a ring of aluminium about 5 feet in diameter and 5½ inches wide is coated with a solution of gum and after drying is dusted with some metallic powder in a thin layer. After this layer has been polished an electro deposit of nickel is made upon the polished layer of baser metal and gold is then electro deposited on the nickel. Each of the four layers is very thin and the composite layer is said to be thinner than the ordinary gold leaf. When the formation of the leaf has been completed, the film is cut to expose the soluble base layer of gum and the ring is immersed in a solvent liquid which dissolves the gum and the metal film falls onto a band moving at the same rate as the ring which last is rotated in the dissolving liquid, the film and paper being finally cut into book size.

Metal-treating Machines.—Three patents, Nos. 1,050,878, 1,050,879 and 1,050,880, have issued to Frank L. O. Wadsworth of Sewickley, Pa., the first for treating metal, the second for densifying metal and the third for uniting metals. The first patent is for a method of treating metal in which the metal is rolled longitudinally and its fibers are simultaneously subjected throughout the entire width of the metal to a progressive continuous displacement in the same direction at an angle oblique to the direction of rolling, this being effected by fine corrugations in the rolls. The patent, No. 1,050,879, is for densifying the metal, while the patent, No. 1,050,880, is for a process of uniting different metals in which a body of one of the metals is heated and there is mechanically kneaded into the surface of the heated body a finely divided substance of a nature to facilitate welding and the other metal is then welded upon the prepared surface.

PATENT ATTORNEYS

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of more than sixty years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to PATENTS, TRADE MARKS, FOREIGN PATENTS, etc.

All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

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Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

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AGENTS. Our absolutely square $30 to $67.50 weekly salary and 30% commission proposition assures steady workers unlimited prosperity. Galloway-Bowman Company, Div. 301, Waterloo, Iowa.

FREE SAMPLE goes with the first letter. Something new. Every firm wants it. Orders from $1.00 to $100.00. Nice pleasant business. Big demand everywhere. Write for free sample Metallic Mfg. Co., 438 N. Clark, Chicago.

BUSINESS OPPORTUNITIES

BIG CHANCE FOR MEN WITH MONEY, to invest in a newly patented Aluminum Solder. Positively the best and only solder that solders aluminum at the present time on the market. It is on the market only six months, and very good results can be shown. Inventor and patentee will sell part or all of patent rights. This is not a patent on paper only, but is actually on market for over six months and only patented July, 1912. Address, Charles R. Erkens, 403 Vanderventer Avenue, Astoria, L. I., New York.

ESTABLISHED MANUFACTURING BUSINESS. Can be easily moved to another location. For further particulars address Opportunity, Box 773, N. Y.

INVENTOR of Monorail Coaster Sled, described in recent issue of this magazine, received many inquiries from the public, desires partner with capital to manufacture. C. T. Rogers, 1777 Broadway, N.Y.

FOR SALE

INVENTIONS TO SELL, bath mitt, double seal envelope, warming cabinet for victuals. Hairpin. Information or models furnished to applicants. Mrs. E. H. Tuthill, Hanover Mich.

INSTRUCTION

LEARN TO WRITE ADVERTISEMENTS.—Earn $25 to $100 weekly. We can positively show you by mail how to increase your salary. Prospectus free. Page-Davis Co., Dept. 89, Chicago, Ill.

PATENTS FOR ENGLAND.

LICENSES negotiated among first-class British firms for successful American inventions patented in England. C. W. Dimes, A.M.I.C.E., 120 Thornlaw Road, West Norwood, London, S. E., England.

PATENTS FOR SALE

PATENT No. 1,017,264 for Bakers' Oven for sale. Have one in my bakery in use for two years. It is the most fuel saving and finest baker ever invented. Lock Box 194, Parsons, Kan.

VEHICLE SWING, combining swings and coasters, Portable and foldable for in and out-door use at homes, kindergarten, playgrounds and public parks. Great favorite with children. Mfg. price, $2 and $3. Zimmermann, 6815 Southpark Av., Los Angeles, Cal.

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PATTERN LETTERS AND FIGURES. White Metal and Brass, for use on patterns for castings. Largest variety, prompt shipments. Send for catalog. H.W. Knight & Son, 92 State St., Seneca Falls, N. Y.

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WANTED Mechanics everywhere to use and sell Vernier Calipers and Levels. Liberal proposition. Send for catalogue and special prices and all particulars. Ernst Smith, Columbia, Pa.

WANTED. An experienced mechanical draftsman for designing all manner of power pumps, etc. Steady employment. State age and salary expected. A. Y. McDonald Mfg. Co., Dubuque, Iowa.

OLD MONEY WANTED. $100 paid for Dime 1894 S. Mint; $8 for certain 1853 Quarters, etc. Many valuable coins in circulation. We pay highest cash premium on coins and bills to 1912. Send stamp for large illustrated Coin Circular. Numismatic Bank, Dept. 30, Fort Worth, Texas.

LOCAL REPRESENTATIVE WANTED. Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. All or spare time only. This is an exceptional opportunity for a man in your section to get into a big paying business without capital and become independent for life. Write at once for full particulars. National Co-Operative Realty Company L-378 Marden Building, Washington, D. C.

INQUIRIES

Inquiry No. 9303. Wanted the name of manufacturer who could make newly patented articles made from 13 to 22 gage sheet aluminum.

Inquiry No. 9304. Wanted the names and addresses of manufacturers of a second hand bag cleaning machine on the order of a carpet cleaning machine.

Inquiry No. 9305. Wanted the name and address of concerns making paper letters and figures.

Inquiry No. 9306. Wanted small hardware and other specialties to be sold in notion and grocery stores. Wanted to buy wholesale.

Pure Air Anywhere All Summer

Yes—even in that back room or basement so stifling last summer that you gave it up as unusable during the hot weather.

Sturtevant (REG. U. S. PAT. OFF.)
Ventilating Fans

solve any ventilating problem no matter how difficult. They force out all the bad air and blow in a cool, steady stream of fresh air from outdoors.

The Propeller Type Fans are for use where large volumes of air are to be handled without piping. They are usually placed in top sash of window or in wall or partition, and force the foul air out-doors or into another room. They ventilate kitchens, billiard rooms, bowling alleys, laundries, restaurants, club rooms and work rooms.

Booklet No. A-P-4 describes these Fans

Booklet No. A-R-4 describes these Sets

Sturtevant Ready-to-Run Ventilating Sets are used when smaller volumes are required, or when it is desirable to remove or supply air a distance through piping. They are used in ventilating and cooling telephone booths, bank vaults, toilets, closets, show rooms, and for taking away odors and fumes in factories, laboratories, etc.

Don't wait until hot weather comes again. *ACT NOW.*

Write us about your ventilating troubles. Tell us whether you want to drive the fan by belt or electricity. Tell us what electric current you have—voltage, cycles, phase, etc. Give us the size and location of your room. Our nearest engineer will advise you without cost to you. We can provide you with the proper fan to fill your exact needs.

B. F. STURTEVANT CO.
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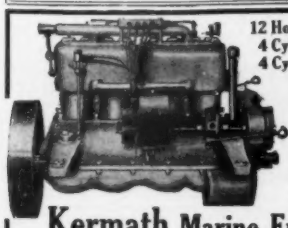
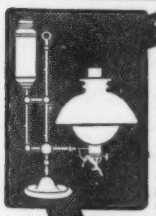


12 Horse Power
4 Cylinder
4 Cycle
Weight 370 lbs.
Speed 600 to 1000 R. P. M.
Made in one size only. A specialized article.

Kermath Marine Engines

the world's standard in 12 H. P. size, are made of the finest materials the market affords and workmanship of pronounced excellence. **Prices $150 to $200.**

Kermath Mfg. Co., DETROIT, MICH. Dept. S



2¢ A WEEK

A safe, very brilliant, powerful, steady, white light. Is better than electricity or acetylene and cheaper than kerosene.

Every lamp is a complete self-contained miniature light works.

Clean—bright—odorless—portable. Made in over 200 styles for every purpose. Fully guaranteed. Catalog free. Agents wanted.

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Legal Notes

Court of Appeals Decisions.—Out of sixteen patent appeals in which decisions were handed down by the Court of Appeals for the District of Columbia on December 30th, 1912, the decision of the Commissioner of Patents was reversed in only two cases. In one of these, that of Perri against Thoma, the decision of the Commissioner was reversed, and priority as to all counts awarded Perri. The other case in which the Commissioner's decision was reversed is that of Broune v. Dyson, in which priority was awarded to Broune.

Some Adjudicated Patents.—Patent No. 709,716 for a dumping wagon has been held void for lack of patentable invention in Leonhardt v. Lynch, 199 F., 790, while the Bronnenkant patent No. 739,824 for a bunion protector has been held valid and infringed in Fisher Manufacturing Company v. Lawrence, 199 F., 799. The Towne patent No. 848,140 for a steering wheel for auto vehicles has been held void on its face for lack of invention in Towne Steering Wheel Company v. Lee, 199 F., 777; the Jordan patent No. 892,668 for apartment wall furniture has been held not infringed in Marshall & Stearns Company v. Murphy Manufacturing Company, 199 F., 772, and the Andrews patent No. 897,513 for a toaster has been held valid and infringed in Andrews Wire & Iron Works v. Wilson Manufacturing Company, 199 F., 798.

Some Adjudicated Patents.—In A. R. Mosler & Co. v. Lurie, 20 Fed. Rep., 433, it has been held that the Canfield patent, No. 612,701, for an igniter for gas, oil or vapor engines, is valid but not infringed; in Theo. J. Ely Manufacturing Company v. Fritsch, 200 Fed. Rep., 424, it has been held that the Hoffman patent, No. 671,136, for a mop wringer, is valid and infringed; the Latham patent, No. 707,934, for a projecting kinetoscope, has been construed and held not infringed in Motion Pictures Patents Company v. Independent Moving Pictures Company of America, 200 Fed. Rep., 411; it has been held in Ruud Manufacturing Company v. Pittsburgh Water Heater, Company, 200 Fed. Rep., 440, that the Ruud patent, No. 761,409, for a gas burner, was construed and held not infringed and that the Ruud patent, No. 875,218, for a gas burner, was void for invention and that the Ruud patent, No. 903,007, for a water heater, was held valid and infringed; and in Williams Patent Crusher and Pulverizer Company v. Kinsey Manufacturing Company, 200 Fed. Rep., 441, it has been held that the Williams patent, No. 939,775, for an improvement in pulverizers, is not void on its face for lack of invention.

Court Decides Against the Taggart Dental Inlay Patent.—Much interest is taken by dentists in the decision of the Court of Appeals of the District of Columbia voiding the Taggart patent, No. 872,978, of December 3rd, 1907, upon a divisional application filed July 12th, 1907, of original application filed January 12th, 1907. This decision, the opinion in which was rendered by Mr. Justice Robb, reverses the decision of the Supreme Court of the District of Columbia, which decision sustained the Taggart patent. Defense was made that the invention had prior to Dr. Taggart's invention been taught, used and operated, at least two years before the filing of the Taggart application for patent. The Court said that it was fully persuaded that the evidence shows beyond a reasonable doubt that for many years prior to the filing of the application for patent the process of making patterns and molds for dental inlays and the like, as expressed in the claims, had been publicly practiced upon many occasions and that it was of no possible consequence that by the use of Dr. Taggart's machine, gold inlays and the like might be produced more cheaply and rapidly than they were produced by dentists who had testified in the case. The Court goes on to say that the art of producing metal castings by means of a mold formed of a wax pattern is very old, was practiced by the ancient Greeks and Romans, extensively used in the middle ages for producing statuary and is known as the *Cire perdu* or "lost wax" process,

IF you could buy a barrel of anything which would increase the light in your factory 19 to 36 per cent, wouldn't you seriously consider the purchase?

You would figure at once the value of that extra illumination, in reduced lighting bills and increased efficiency of employees—and then ask the price of the barrel.

That is a fanciful way of putting our proposition, but it is all fact, nevertheless. *19 to 36 per cent actual increase in light* (depending on the present condition of your ceilings and walls) is what you will gain, if you paint the interior of your factory with

RICE'S MILL WHITE

Rice's Mill White is an *oil* paint, not a cold water mixture. It gives you a glossy tile-like surface which captures every ray of light entering the room and reflects it down on to your machinery and into previously dark corners of your plant.

Read what the Kellogg Toasted Corn Flake Company write us:

Battle Creek, Mich., Feb. 5th, 1912.

Dear Sirs:

Before using your product our factory was painted with cold water paint, which continually collected dust and dirt. When becoming stained or soiled it was impossible to wash off. After several coats had been applied it started to peel and flake off.

The sanitary conditions of our plant have been improved wonderfully. We now have a tile-like enamel surface to which dust and dirt does not readily adhere, and which can be washed and kept perfectly clean.

From general appearances, we should judge that we are getting about 50% more light than was formerly obtained before Rice's Mill White was applied.

Yours truly,

KELLOGG TOASTED CORN FLAKE CO.

Rice's is the *original* "Mill White" paint. No other paint manufacturer can use the Rice process. No imitation has the *lasting* qualities of Rice's Mill White Paint.

Rice's Mill White Paint is sold direct from our factory in barrels containing sufficient paint to cover 20,000 square feet, one coat. If you have that area of ceiling and wall space to cover,

Write for Booklet and Sample Board

Ask for a copy of our booklet, "More Light." *Write today.*

RICE'S GRANOLITH

A tough and elastic permanent finish for concrete walls. Becomes a part of the cement to which it is applied. One coat sufficient, unless a gloss is desired. Makes the best possible primer on inside concrete and brick for a second coat of Rice's Mill White Paint, giving a tile-like enamel finish at no more expense than lead and oil paint.

For Concrete Surfaces

U. S. Gutta Percha Paint Co., No. 23 Dudley St., Providence, R. I.

It begins to look like we're back numbers "Billy"

Painted by C. H. Taffs. Copyright 1913, by The Republic Rubber Co.

PROGRESS

Our wonderful nation is an ever-growing, ever-progressing one. We have planned, we have dug, we have plowed, we have builded, we have mined, we have made and we have sold. We have neither inherited our wealth nor have we laid tribute upon weaker nations. But behold! We are the richest of them all.

Such is progress—the spirit that has made this nation the leader of nations.

Progress demanded something to replace "Old Dobbin," and American genius replied with the first crude automobile. This evolved into the modern motor car, powerful and massive—its very hugeness making it swerve and skid, endangering life. So Progress demanded a safe-guard. Came the often-inadequate metal studs, and the first far-from-satisfactory rubber knobs. And Progress called once more.

Then was invented the Republic Staggard Tread Tire, the tire that gave a real protection against skidding, an-all-to-be-desired brake control, and a much-increased mileage—truly The Tire Perfect.

And Progress looked, and was pleased.

THE REPUBLIC RUBBER COMPANY
YOUNGSTOWN, OHIO
Republic Staggard Tread. Pat. Sept. 15-22, 1908.

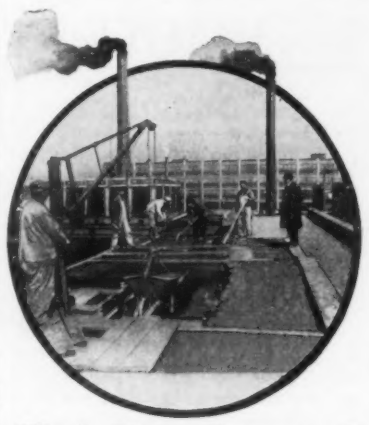
Trade-mark Notes

A Trade-mark Decision.—In the case of *ex parte* United Roofing and Manufacturing Company Mr. Commissioner Moore has decided that the word "Lakeside" was held improperly and refused registration on the ground that it is a geographical term. In his decision the Commissioner called attention to the fact that there are sixteen or seventeen post offices in the United States called Lakeside, but none of these are well known places and the Commissioner says that he cannot agree with the holding of the examiner that it is probable that an ordinary person would regard Lakeside as a geographical term but believes that the word would be regarded as fanciful by a large majority of observers and therefore decides the mark to be registrable.

Trade-mark Oppositions.—In The Irish Industrial Development Association v. Parrett, the Commissioner of Patents following a number of cases, such as Lang v. Green River Distilling Company, Natural Food Company v. Williams, and Johns-Manville Company v. American Steam Packing Company, has held that it is not necessary in order to sustain an opposition, that it should appear that the opposer is entitled to register the mark, but that it is sufficient that the mark should have been used in some manner analogous to trade-mark use and that the opposer has such an interest therein that he would sustain or be likely to sustain actual damage by the registration of the trade-mark by another.

Copying a Trade-mark in China.—The Shanghai *Daily News* tells how, at the mixed court in Shanghai, which has jurisdiction over Chinese residents, a Chinaman, Tai Yuin-tsen, was charged with selling goods to which a false trade-mark had been applied, the false trade description being that certain boxes containing soap manufactured and sold by the Chang Sing Woo Ku Company (Limited) bore the name and stamp in English of soap manufactured by W. Gossage, for which Mr. C. R. Burkill is the local agent. Mr. Burkill stated that he saw the boxes of soap on a barrow, and recognizing the trade-mark had the man detained by the police. His firm were the sole agents for the manufacturers. A stencil of the trade-mark was found in the factory, and there were 214 boxes of soap there bearing the trade-mark. The defendant was fined $100, and the court ordered that the boxes already stamped. with the stencils, be confiscated. Had we some such summary punishment for trade-mark infringement, in this country, there would be less trade-mark piracy.

A Peculiar Trade-mark Condition.—In a recent decision by the Commissioner of Patents, it appeared that a registration certificate was issued in 1908 to "The American Rolling Mill Co. of Middletown, Ohio, a corporation organized under the laws of the State of Ohio" upon an application purporting to be filed by such company. Later application was made "The American Rolling Mill Company" for the cancellation of the registration, which application stated that the registrant company is a corporation organized under the laws of the State of New Jersey and under the laws of no other State and that the statement that the company was organized under the laws of Ohio was an error due to accident, inadvertence and mistake. After due proceedings an order was duly entered by the Commissioner of Patents canceling the registration. An application was filed by "The American Rolling Mill Company, a corporation duly organized under the laws of the State of New Jersey and located and doing business in Middletown, Butler County, Ohio," for the registration of the same mark and the Examiner of Trade marks has refused registration on the last application in view of several registrations. The petitioner then sought to have the original registration reinstated. In denying such petition, the Commissioner suggests that it does not appear that the petition could obtain any legitimate benefit from such a registration, that it is believed the Comissioner had ample warrant for canceling the registration but that he has no authority to reinstate said registration to a non-existing corporation.



Why build your factory roof more than two inches thick?

Concrete roofs are admittedly the highest grade of fireproof roofs. Their great weight and resulting high cost have been the only objections urged against them. Were it not for these two factors the concrete roof would be now—as it is destined to be in the future—the universal fireproof roof.

With Self Sentering you can build a strong, light, concrete roof two inches thick. You can build it without form work or centering of any kind. You can easily and economically build roofs of any character—pitched, dome, saw tooth or monitor—as well as flat roofs.

Self Sentering is a new form of expanded metal for concrete reinforcing and general fireproofing. It is a combined reinforcing and centering—a one-piece steel lath and stud.

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Send for the Fireproofing Hand Book

It contains a lot of information in regard to low cost fireproof construction, with many diagrams and illustrations.
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The Gyroscope

The mysterious behavior of the gyroscope is a source of wonder to everyone. From a toy, the gyroscope is being developed into a device of great practical value. Its theory and its method of action are set forth up to the latest moment in the Scientific American Supplement. The following numbers are of great interest and usefulness:

Scientific American Supplement 1501 Treats of the Mechanics of the Gyroscope. A clear explanation without mathematics.

Scientific American Supplement 1534—"Little-known Properties of the Gyroscope" describes a peculiar action not generally observed, and dismisses the effect of this property upon the motions of the planets.

Scientific American Supplement 1621—The Gyrostat for Ships describes the construction and application of the principle to prevent rolling of vessels.

Scientific American Supplement 1643—The Gyroscope for Balancing Aeroplanes, takes up this interesting field, which the gyroscope alone seems capable of occupying.

Scientific American Supplement 1645—The Theory of the Gyroscope, is an excellent article, treating the subject mathematically rather than popularly.

Scientific American Supplement 1649—The Gyroscope, is an article giving a full discussion of the instrument without mathematics, and language within the comprehension of all interested.

Scientific American Supplement 1694 Gyroscopic Apparatus for Preventing Ships from Rolling, takes up the Schlick invention described first in No. 1621, and discusses its action and results fully.

Scientific American Supplement 1716—A Recent Development in Gyroscopic Design, illustrates a new form of gyroscope and mounting adapted to engineering uses.

Scientific American Supplement 1741—Gyroscopic Balancing of Aeroplanes, tells of various suggested methods of maintaining equilibrium.

Scientific American Supplement 1814—The Regnard Aeroplane, describes the latest design of aeroplane stabilizer, from which great things are expected.

Each number of the Supplement costs 10 cents. A set of papers containing all the articles here mentioned will be mailed for $1.00. Send for a copy of the 1910 Supplement Catalogue, free to any address. Order from your newsdealer, or the publishers

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Write for Booklet 23

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The stones won't glaze—they last a life-time.

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Achievements of Military Aircraft

(Concluded from page 307.)

observers, in aeroplanes, wears them out very quickly. Rain and snow will seriously affect the lifting power of the dirigible and may bring it to earth, as was the case with the "Parseval II.," which was compelled by a rain-storm to descend during the German maneuvers in 1910 when scouting for the Red side, and was captured by Blue. The comparative slowness, bulk and vulnerability of the dirigible have given rise to the supposition that it will fall an easy victim to the aeroplane, but the increasing speed and lifting power of such large vessels as the latest Zeppelins, and the fact that they are better suited as a platform for machine or pneumatic guns, and can rise quicker by using their planes and vertically by casting out ballast, while the aeroplane can ascend only at an angle and in spirals, seems to imply that the odds are not so greatly in favor of the aeroplane being able to get immediately over the airship and rain down missiles and explosives without risk to itself. Special aeroplanes, to be armed with machine guns, are being built in England for the express purpose of attacking airships, and there is no doubt that a combined attack by a number of these, with their concentrated fire from several directions, would be difficult to deal with. Even in this case however we must remember the rigid type of dirigible, built in many gas-tight compartments, could safely stand the piercing of some of these by splinters, or even the evacuation of one or two sections, if provided with sufficient margin of lifting power and ballast. Beyond the chance of injury to some of the mechanism or the crew, the dirigible has little to fear from machine guns firing ordinary small-arm ammunition, the leakage of gas from bullet holes in the envelope being comparatively negligible. Although appearing to offer a huge target in the day time, it will usually travel at such a height and pace and be able to change direction and altitude so easily in order to prevent artillery from getting the range with incendiary projectiles, besides taking possible advantage of clouds as cover from view, that it will not necessarily be an easy mark for the gunner. The sighting of guns at high elevation is a difficult matter, with the range altering rapidly all the time. A well known artillery officer, who has made a study of the subject, has gone so far as to say that at a height of 3,000 feet it is impossible to hit aircraft by fire from guns on the ground. By night an airship is almost invisible; it has been found difficult to distinguish even in clear weather and when look-outs have been warned and search-lights used.

Harnessing the Public Water Power

(Concluded from page 311.)

Dam. Some of the surplus is leased to light the town of Fallon.

Unique Development of Power.

One of the unique water-power plants is on the Huntley project, where a drop in the canal is utilized in pumping a portion of the water to a higher level than the gravity canal, and where the power and pumping units are combined. In this case, which reminds us of lifting one's self by the boot straps, the falling water operates a turbine wheel connected directly with a centrifugal pump. The entire operation is simple and automatic and requires only such attention as will prevent the entrance of trash and the regulation of the amount of water. About 4,000 acres are thus supplied.

A similar plant is being installed on the Lower Yellowstone project in Montana to reach 3,000 acres of high land.

On the Yakima project the irrigation of considerable areas of high land is accomplished by means of a battery of hydraulic rams which for these relatively small installations are probably the simplest and most economical device yet employed.

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The selection of a watch is not a case of sentiment or fad with railroad men. Their watches must be the best. Both men shown above carry Hamiltons and that they are just two out of many thousands of Hamilton owners on railroads is proven by this fact: **Over one-half of the men on American Railroads maintaining Official Time Inspection carry the**

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Ask your dealer about them; also about fitting your present watch case with a HAMILTON movement.

Write for "The Timekeeper" — It illustrates and describes the various HAMILTON models and is a book well worth reading if you are thinking of buying a fine watch.

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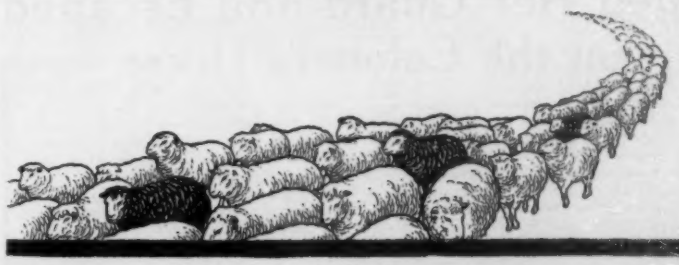

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She had slipped within the Union lines to get information for the Confederacy, only to be caught by Colonel Starr of the Ninth West Virginia. She faced hanging. She was inspired to desperate action. She watched her guard. At last in the night she caught him unawares, and shot him with his own rifle. Like a flash she was astride the Colonel's horse, and with a clatter of hoofs, was off. She came back later, but not alone. Two hundred Confederates were at her back. The tables were turned. She and her Confederates rode off with the captured Colonel and his men. Without promise of glory, with the risk of shame and death, this Virginia Mountain girl, Nancy Hart, went her fearless way in the drama of our Civil War. Her one moment of fear was when she faced the camera that caught her photograph, now shown in the

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A Million Words

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New York

Unique Development of Power.

One of the most unusual power plants is located at Williston, North Dakota. Here the Reclamation Service is operating a large coal mine, delivering the lignite to a nearby power plant, where power is generated and transmitted to the Missouri River, near Williston, about six miles, and Buford, 24 miles distant. At these points are floating barges upon which are set the large pumps operated electrically. The barges are attached to the bank by flexible pipes capable of being extended or shortened to meet the shifting of the stream channel. In winter these barges are hauled up on the bank out of the way of ice damage.

The Street Car Ambulance

(Concluded from page 316.)

tients over the street car tracks of any city. The ambulance was built for a street car company in Brazil and will operate to and from the outlying hospitals in the city of Bahia, access to which cannot be readily reached by the ordinary methods used in bringing patients to hospitals.

The car is divided into five compartments, providing a nurse's room just outside of each hospital room, and a fumigating compartment in the center.

The car is to be used for contagious disease patients as well as others, and for this reason the designer had to use considerable originality in order to locate the fumigation compartment so that it might be easy of access, and at the same time isolate the patient from the employees of the car. The fumigation compartment is located in the center, is not of easy access to either hospital room, and has a width of 2 feet 5/8 inch. It is hermetically sealed from the remainder of the car with the exception of a hole through each crosswise partition, through which the fumigation process takes place. This arrangement obviates the necessity of either nurse or doctor entering the hospital compartment. At either outside end of the disinfecting room is a paneled door.

The two largest compartments of the car show the hospital arrangements, each room accommodating two iron beds supplied with rubber-tired rollers, springs and the regular mattresses. The outer walls of the two compartments are so arranged that they may be easily lowered to permit of receiving a patient from a stretcher. When lowered they form a continuation of the floor of the car and are held in position by means of iron supporting rods. Each compartment is sufficiently well lighted by an arrangement of double paneled wire glass windows located above each bed and frosted upon the inside.

A ventilating hole 8¼ inches in diameter is located under each bed. This is covered by a removable register into which may be deposited any air-distilling material desired.

Separating the car body proper from the platform is a steel bulkhead without openings of any kind, completely isolating the crew of the car from patients suffering from extremely contagious diseases. Every precaution has been taken by the designer to prevent infection arising from such a source, and to this end in place of the ordinary cord bell an electric bell is used.

Latent Pressure in Rock Strata

ALTHOUGH all underground borings such as mine galleries are subjected to the effects of the weight of overlying strata as a natural consequence, it appears to be found that the effects which are noticed in such cases are not entirely due to weight of the soil, so that other causes must be supposed, especially the action of the latent pressure coming from earth movements which may have been maintained clear up to the present time. The French scientist, Lapparent, was led to think that all the rock strata of the globe are more less compressed from mechanical movements which they underwent in the course of ages. Chief Engi-

The Safe Garage

Built as strong as a steel sky-scraper

Unless you have investigated, you little realize the strength, the durability, the permanency, of Pruden System Construction. It is built of heavy galvanized steel. A permanent building in movable form. The use of bolts instead of rivets make it portable. Simple and easy to erect. No net work of framing. By our patent system the units interlock and reinforce each other, providing a building of extreme strength and rigidity. Never needs repairs. Never depreciates in value.

Pruden System

Fireproof {Port-able} **Garage**

Absolutely safeguards its contents against fire, wind, weather or thieves. It is **positively fireproof.** No wood. **Absolutely weatherproof,** too. Double thick joints keep out wind and rain. Sure proof against thieves and vandals. Windows are bar-locked. Doors have ingenious safety bars. Expansion joints take care of changes in temperature. Successfully used in any climate. Absolutely practical. Perfect in every detail

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Write for catalog, stating name and model number of your car, or for what other purpose you need a building, so we can also advise size of building best suited to your needs. Immediate shipments from stock. Freight paid east of Rocky Mountains.

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Quotations promptly furnished

We are the Original Power Loom weavers and manufacture

Pompeiian Bronze Screen Cloth

Also an extensive line of other wire cloths both galvanized and painted.

Clinton Electrically Welded Fabric for concrete reinforcing
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CLINTON WIRE CLOTH CO.
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Weaves and perforations in any and all metals

neer Morin of the Lievin mines in France made some observations on this subject. While mine tunnels were being put through, or shortly after, he noticed slow movements of the ground which cannot always be accounted for by the simple weight of overlying earth. Certain places showed an abnormal pressure at various levels under ground, and at other points he found very great pressures at small depths, and on the contrary low pressures at great depths. Considering various observations, he is led to believe in a latent pressure in rock strata.

The Problem of the World's Oil Supply

Consuming the Product of Ages in a Year

IN view of the importance of the many industries which rely upon oil as fuel, the question of the possible exhaustion of the world's oil supply deserves the gravest consideration. There is every indication that we are face to face with this possibility. In the oil districts themselves the cost of crude oil has so risen that in the Russian, American, Roumanian and Salician fields record prices are being obtained. It may be remembered that a short time ago a vessel endeavoring to obtain heavy oil in New York had to pay $12 a ton, which is about the price at which it can be obtained in England. It may be that the present high cost of oil is partly due to financial jugglery, but on the whole there can be little doubt that it is chiefly due to a real shortage in the world's supply.

Prof. Lewes, lecturing before the Royal Society of Arts in England on the subject of Liquid Fuel, said that as long ago as 1886, when the Pennsylvania oil fields were in their zenith and flooding America with oil to such an extent that the barrels were of more value than the oil itself, Prof. Leslie, one of the greatest authorities on the subject, addressing the oil mining experts in Pittsburgh right in the heart of that country, put it to them in the clearest possible way that the enormous floods of oil they were getting must of necessity soon come to an end. "It is clear," he said, "that in the laboratory of nature you can only have oil being formed at about one ten-thousandth or millionth the rate at which it is being consumed, and inasmuch as the strata contain only a certain quantity of oil, the tremendous output will mean that these oil fields will only be gleaning with difficulty the dregs we have left behind." Of course, considerations of this kind cannot be expected to influence in any way business men, but Prof. Leslie's words have proved to be absolutely true as regards that field, which was the first to show signs of exhaustion, and at the present moment in that district, which yielded those floods of oil, only barrels are now obtained where the yeld was hundreds of tons. The Baker Field, too, is showing signs of exhaustion. The Texas Fields have been opened up, and supply is rising, and also the California Fields; these give the supplies to America. As for the whole world's production, although it has been doubled within the last ten years, this result has only been obtained by the multiplication of wells not twice, but twenty-fold, and by the opening up of new oil fields. But in spite of this, it would seem that the supply cannot keep pace with the demand. There is no indication that the present high prices will be lowered. They may even increase. Meanwhile the oil consumption of the world is growing at an enormous pace. Gasoline, which a quarter of a century ago was regarded almost as a waste product, is now in such great demand that in England alone, which consumes only one thirtieth of the total oil supply of the world, the consumption has doubled during the last four years, eighty million gallons having been used in 1912.

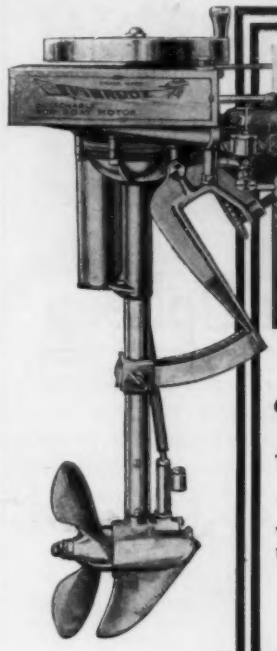
In these circumstances, therefore, the problem of finding substitutes for the kinds of oil in greatest demand becomes of the first importance. Gasoline, which is a light oil, is at present the most important, and the general oil shortage is chiefly felt as it affects the supply of gasoline. These considerations have led to the establishment of a Petrol Committee by the Royal Automobile Club, and representing practically every known motoring organization. The first report was published last summer and was devoted entirely to the subject of transport and handling generally, with due consideration of the restrictions existing as to storage, and the result may be summed up in the statement that the committee arrived at the conclusion that even if the restrictions were reduced and transport cheapened, gasoline might, and probably would, remain equally dear. The second report, published very recently, considers possible substitutes for gasoline. So far it has devoted its attention to one, viz., benzole. Benzole as sold in the trade under the name of 90 per cent benzole consists of three pure products, benzene, toluene and xylene. All these are hydrocarbons, but the proportions of hydrogen and carbon are different in the three compounds, and they have different boiling points, and consequently different freezing points. It is the lower freezing points of the toluene and xylene which are so valuable, as the benzole alone, that is pure benzene, freezes at so high a temperature that it would be inconvenient for winter use, if not altogether impossible on many occasions.

The proportions in which the three constituents are found in 90 per cent benzole are given as 70 per cent to 75 per cent benzene, 24 per cent to 29 per cent toluene, and about 1 per cent xylene. The term 90 per cent benzole is entirely a trade name, and is no indication of the purity of the benzole. It merely implies that the mixture of benzene, toluene, and xylene is such that 90 per cent of the mixture will distill over below 100 deg. Cent. Pure benzene would be disadvantageous, not only because of its tendency to freeze in winter, but also because its pushing power would be less. It has been found experimentally that the presence of toluene means considerably more power on the hills. There are usually a number of impurities in benzole, but this can be readily obviated by giving it efficient washing.

If the washing and final rectification be carefully done, the quantity of impurities remaining in the benzole ought to cause no trouble whatever.

The committee found that not only could benzole be used as an effective substitute for gasoline, but that it was even more efficient. They say: "With reference to the increase in mileage obtained by the use of benzole, this is only to be expected. The whole question is one of calorific value per pound of fuel. Assuming petrol (gasoline) to have a calorific value of 19,500 British thermal units per pound, and 90 per cent benzole to have a calorific value of 20,000 British thermal units per pound, and taking petrol (gasoline) at 7¼ pounds per gallon and benzole at 8.8 pounds per gallon, this gives benzole an advantage of 20 per cent in calorific value over petrol *per gallon;* hence the increased mileage."

As against the optimism of this part of the report we must set the facts that the present supply of benzole is so small that it stands no chance of rivaling gasoline, and that no evidence is yet available as to what are the true commercial possibilities of increasing the supply of benzole. It must not be forgotten that the production of benzole from coal involves coking about half a ton of coal to get a gallon of benzole. And if benzole is to take the place of gasoline it must be produced by the millions of gallons, which means that a market must be found for the corresponding millions of tons of coke. These are questions which have yet to be investigated, and it is hoped that with the publication of the third report of the Petrol Committee we shall know exactly where we stand.



Auto Pleasures Are But Half When You Cannot "Evinrude"

I'M GOING "EVINRUDING"

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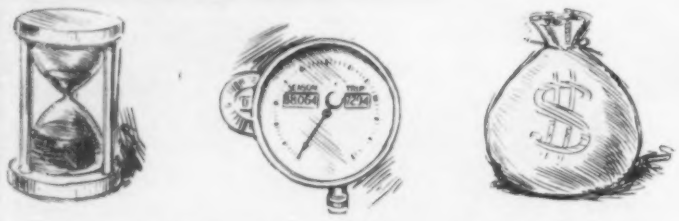

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Summary of the Seventh Annual Report of the Carnegie Foundation for the Advancement of Teaching

THE seventh annual report of the president and treasurer of the Carnegie Foundation, which has just appeared, covers the year ended September 30th, 1912.

The report of the president, like the former reports, is divided into two parts —the first referring to the current business of the year and dealing with questions more directly pertaining to the administration of the foundation; the second part being devoted to current educational problems of a larger and more general nature.

The first part of the report includes a careful statement of the whole question of pensions for teachers, for Government employees, and for industrial employees. This statement contains the results of the examination of practically all of the pension systems now in operation anywhere, and leads finally to a discussion of a feasible pension system for the public school teachers of a State. As the report points out, the bills which have been introduced in the various legislatures almost without exception violate fundamental actuarial conditions, and have been framed without study of the essential conditions which must be fulfilled by any adequate pension system. The material brought together in this report, the examples of the failures of pension systems which have occurred, as, for example, that in New South Wales, and the precarious situation in which many State pension systems now stand, make this portion of the report one of great practical value to the authorities of any State contemplating pensions either for teachers or for State employees.

President Pritchett, in arguing finally for some form of contributory pension system for public school teachers, points out clearly the difficulties of the contributory system, the necessity for the most careful actuarial advice, and the public nature of the questions which are involved in a distribution of the cost of such a pension system between the State and the teacher.

Following the discussion of these pensions, a complete history of the methods by which the Carnegie Foundation pensions were arrived at is given; the process through which the trustees worked is told in the frankest manner; the difficulties which they encountered and the differences which arose out of the fact that the pensions of the Carnegie Foundation are not contributory, but have come as the result of a free gift, are made clear. The literature on pensions now at the disposal of the Foundation is probably the most complete in the statement of such problems that has ever been brought together, and the discussion here made cannot fail to be of value to a college, a State, or an industrial association which is studying the pension problem; and the pension problem to-day is one of the insistent problems of modern social progress.

The second part of the report is devoted to such subjects as the matter of college entrance requirements, admission to advanced standing, a statement of medical progress, university and college financial reporting, advertising as a factor in education, education and politics, and finally, sham universities.

All of these subjects are discussed in the frank and specific manner which has hitherto been used in these reports. In recounting the extraordinary medical progress of the last five years attention is called to the connection which still exists in the United States between reputable colleges and unworthy medical schools. The lessons of the recent Bulletin on Medical Education in Europe are also brought clearly forward. During the last five years the mortality among unworthy medical schools has been most satisfactory. The number of such schools in the United States has been reduced by about one third and the number of students attending them by about one quarter, and this diminution has occurred in exactly the places where it ought to

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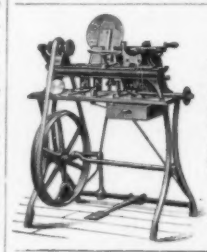

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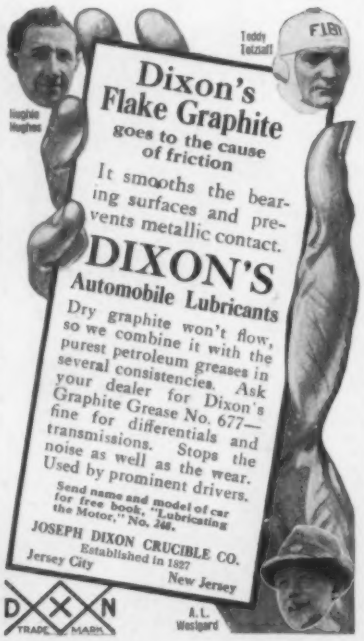
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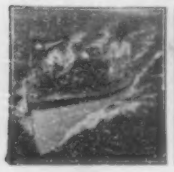

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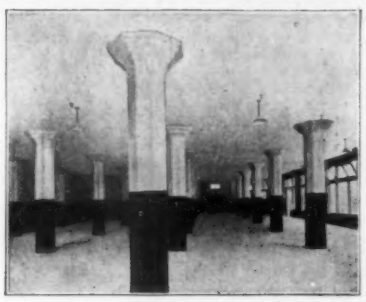

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occur—namely, in the elimination of the unfit.

The section devoted to education and politics discusses not only the recent remarkable changes in the University of Oklahoma, the University of Kentucky, and the University of Montana, but also deals with two other tendencies in political life which are profoundly affecting education: first, with the rivalry which comes from competing State institutions, and secondly with the practice inaugurated almost wholly within the last ten years in States where there are no State universities, of subsidizing institutions that are under private control. In a number of States this process has gone on until it has enormously increased the number of privately controlled institutions which share in State appropriations. So marked has this tendency become that the question of State appropriation to education without State control is one which ought now to be frankly and squarely met.

Under sham universities the report deals with conditions such as hold, for example, in the District of Columbia, where commercial enterprises without endowment or facilities are chartered as educational institutions under the loosest conditions, which enable them to appeal to the credulity of ignorant students throughout this and other countries under high-sounding names and under the shelter of charters granted by the general government. A bill now before Congress aims to correct this situation.

A New Study of Putrefying Bacteria

AT M. Metchnikoff's laboratory at the Pasteur Institute, M. H. Tissier is engaged in observing the action of various microbes in putrefying meat or milk, and compares the effect of different bacilli upon albuminoid matter. In his late experiments he makes use of the leading meat putrefying microbes such as *B. perfringans*, *B. proteus vulgus* and others. As to the matter to be attacked, this is proteic matter, such as albumen from blood, eggs or plants, also fibrin, casein, etc., besides foods such as lean meat, white of egg, milk, cheese, and many other products. The tests under microbe culture in large glass bulbs lasted one month. His tables show that the greatest action is given by the anaerobic bacilli, as *B. putrificus* and the two bacilli taken from intestinal sources, the *B. sporogene* and *colicogene*. The effect of the *perfringans* is less marked, especially with albuminoid matter used alone, but hydrocarbons put along with this will increase the action, such as sugar or starch. Of all the microbes he used, only the *proteus* produced indol and the *perfringans*, indol and phenol. None of them formed toxic substances.

New Fibers for Textile Use

FABRICS known by the general name of vegetable silk are now being made from a number of vegetable fibers, and owing to recent researches this number is likely to increase before long. The fiber known as kapok has been in use for some time as a stuffing material for life-belts, mattresses and cushions, and it is now coming into use for making vegetable silk. At Chemnitz, Germany, the manufacture has been going on for several years past, and the kapok fibers are first put through a chemical treatment before spinning into threads. The kapok fiber comes from the plant known as *Ceiba pentandra*, but it is not the only source of vegetable silk, for in fact the same works is making use of the "akon" fiber, this being taken from the plant *Calotropis procera* and the like, which are of common growth in India, the Malay archipelago and east Africa. Good results are also obtained with the fibers of the *Chlorocodon Whytei*, a vine growing in the region of Amami. Another source of fiber is the material which surrounds the seeds of the *kickxia elastica* and others, and by a proper treatment these can be made up into threads which have somewhat the same luster as silk.

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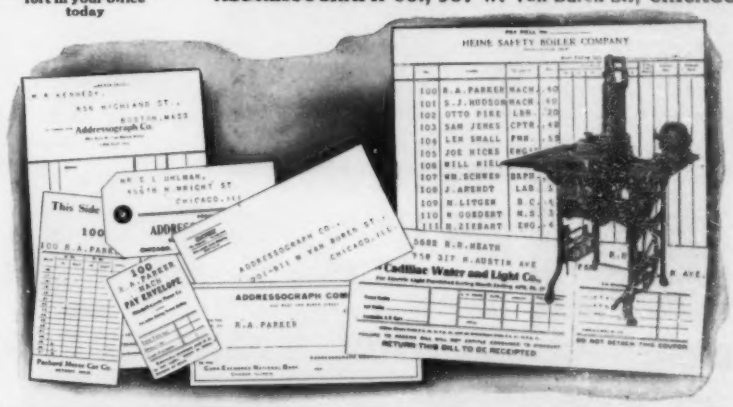

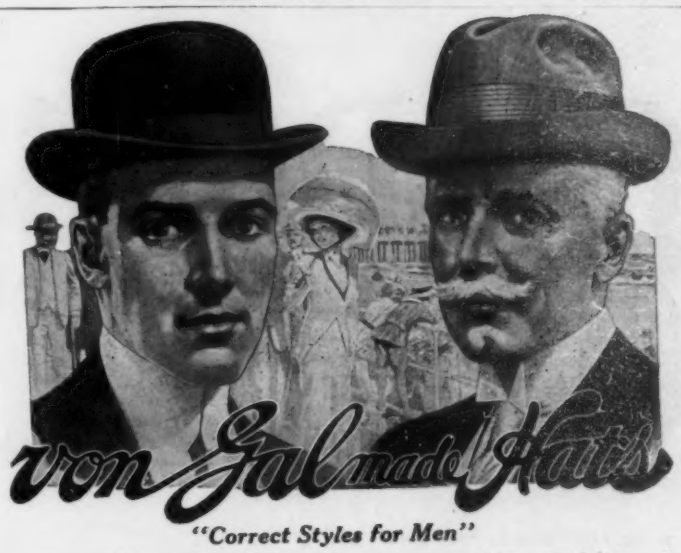

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(12765) E. B. asks: Please give me the rule for trisecting any angle, as I think that this would be of interest to a great many readers of the SCIENTIFIC AMERICAN. A. Angles, excepting a very few, cannot be trisected by ruler and dividers. They are, however, so divided by the use of certain curves. A method of trisecting any angle was published in our SUPPLEMENT 1895, within a year, and in SUPPLEMENT 1733, and so we cannot find space to republish it so soon again. We send the papers for ten cents each.

(12766) N. V. asks: Is the statement made by a certain person, that as far as invention concerns, the word "invention" has really lost its meaning, and that it is nothing more than a proper application of well-known mechanical principles. Is this correct or not? A. The word "invention" is derived from two Latin words which mean "to come upon." Anything therefore which anyone finds out and embodies in a material is an invention within the meaning of the word in a material sense. In a general sense, a poem, an oration, or a musical composition, is also an invention. That certain principles must be respected in inventing, is only to say that one cannot violate laws of nature and force, or of mind and spirit, and still succeed. We cannot agree with the statement that the word "invention" has lost its meaning, or that invention has come to an end. There are more unknowns than ever. It was Sir Isaac Newton who said, "I seem but as a child, playing on the seashore, now finding some pebble rather more polished, and now some shell rather more agreeably variegated than another, while the infinite ocean of truth extends itself unexplored before me." And every great discovery since his day has only made visible greater reaches of the unknown than had appeared before. How great the unknown which the finding of radium has disclosed! Nor is there any end in sight.

(12767) R. H. C. asks: 1. Is there any method by which the image on a photograph print can be made to disappear and reappear at will? If so, will this process affect the permanence of the print in any way? A. We know of no way in which a photographic print can be made to appear and disappear completely. If it could be done, it would most certainly injure the permanence of the print. 2. Could you supply me with a book or books, suitable for a high school graduate, covering the science of geology in as thorough a manner as the limitations of self-instruction would permit? Is there a book or chart showing the local geological phenomena? A. We recommend and can supply you with Scott's "Geology," which is a recent work, and which seems to us to come within the lines you lay down, a book which a high-school graduate can read with pleasure.

(12768) J. E. K. asks: Will you please tell me what position the needle of a compass would take at the north pole and at the magnetic pole? A. At the earth's north pole the north end of the needle of a compass would point to the magnetic pole of the earth, or toward Hudson's Bay. At the magnetic pole the needle of a compass would not have any power of direction, if it would be able to swing at all. If a needle is hung so as to swing up and down, the north end would point directly down toward the earth.

12769) J. F. asks: Can you explain the reason why a feather, especially a gray one, may be used as an X-ray on a small scale by taking two cards and punching a hole through them, then laying the fringe across the hole, and cementing the fringe, then cutting same off next to the quill, so that cards may be pasted together? A person may see the lead in a pencil or the bones in the finger. Can you give any explanation for this penetrating power? A. What you see by looking through the fringes of a feather is not an X-ray effect at all. You can see the lead in the rod of a fire poker as well as in a lead pencil, or the bone in a round stick of wood as well as in your finger. Anything held in front of the hole in the card will show the same effect. We have one on the desk before us which has a piece of coarse cloth, gauze, and it works just as you describe. We have had this for a number of years. The curious appearance is due to the bending of the rays of light around the fine meshes of the cloth or feathers. It is called diffraction of the light, and is described in the text-books of higher physics.

(12770) C. E. A. asks: Will you kindly inform me whether a fish sleeps or not, and how? Your consideration will be appreciated. A. Upon the question, "Do fishes sleep?" the Encyclopædia Britannica, last edition, has this statement: "There is little doubt that all living beings require periods of repose alternating with periods of activity. . . . . Naturalists have observed many of the lower animals apparently in a state of sleep. Insects, crustaceans, fishes, reptiles may all be observed occasionally to be almost motionless for considerable periods of time." Animals without eyelids cannot of course close their eyes as the higher animals do.

(12771) J. L. asks: I would like to ask you about radium. 1. How is it discovered? A. Radium is an elementary substance, just as iron and copper are elements. It is found in exceedingly minute quantities in pitchblende, a mineral which is mined in Bohemia, and has not been found in any other part of the world thus far, although many claims have been made that it has been found in other places. There is no reason why it might not be found elsewhere in quantity. 2. Is there any known method by which it can be located? A. It would be discovered by one who knows the character of rocks and minerals, and who should study the locality to find if such rocks might exist in that locality. 3. What appearance has it when found? A Pitchblende is a shiny black rock, which might be taken for a piece of anthracite coal at first glance. It is very much heavier and harder than coal. 4. What is its force or energy when applied to anything? A. There is not enough radium in a piece of pitchblende to show any energy, nor would there be enough in a ton of the rock. We have published many papers upon radium. You will find them indexed in our Catalogue of Valuable Articles, which we are sending you with this letter. We shall be pleased to fill your orders for any papers you may select at ten cents a copy. See page 23 of the catalogue.

(12772) J. W. W. asks: Will you please send the chemical analysis of ocean or salt sea water, i. e., same analysis of waters in some of the larger bodies of salt water? A. In sea water there is about 3.5 per cent of solid substances altogether in weight, or 35,000 parts in a million. This gives weights as follows:

Sodium chloride	27,213
Magnesium chloride	3,807
Magnesium sulphate	1,658
Calcium sulphate	1,260
Potassium sulphate	0,863
Calcium carbonate	0,123
Magnesium bromide	0,076
Total of solids	35,000

Our figures are taken from the latest book on the subject, "The Depths of the Ocean," by Sir John Murray, published last year, which we can send for $7.50 by express prepaid, and we shall be pleased to receive your order for a copy. It is the best work we know upon the ocean and the methods of its exploration.

(12773) W. B. B. writes: The matter I wish to discuss may be old as the hills, but for the reason that I have never seen the theory advanced by any authority, I call your attention to it. Some years ago, while listening to the late Daniel Drawbaugh (inventor of the telephone) a schoolmate of mine, explaining the operation of his electric clock, in about these words: "I knew that a constant current of electricity is passing round the earth from east to west, created by the opposite movement of it (the earth). I conceived the idea of securing enough of this current to give a sensitive effect; then again I planned to give movement to a clock by planting deeply in the earth two copper plates with wires attached, one on the eastern side, the other on the western, and these wires to connect with a large permanent magnet; the key to the magnet being attached to the long wire of the pendulum, and the swing of the pendulum this tilting the key, that the ends would alternately touch the positive and negative poles of the magnet, and thus giving movement to the clock, and I succeeded." The clock had been running about fifteen years when Drawbaugh explained it to me. After thus hearing his explanation, I remarked: "Then, according to your theory, Dan, the earth must be a great dynamo, the first, original one, and in operation so long before we knew what a dynamo was." This line of thought finally led me to consider that really the movement, or rather rapid motion, of the earth revolving from west to east must bring about dynamic results, and that like any other dynamo, electricity is thrown off from the axis in a powerful current, and this electric current is shown in the Aurora Borealis or northern light. So far, so good. Now, such being the case, what effect would this current have on a man standing on the exact pole? If my theory proves the correct one, could a man reach the true pole and live? If I am correct, neither of the so-called pole discoverers ever reached the true pole. Am I right? A. Your observations upon an electric current in the earth are not new, although doubtless original with yourself, and the running of a clock by electricity generated in the ground has been done by others in the past, although we cannot decide the question of priority. We described the construction of such a clock in SUPPLEMENT 1300, December 1st, 1900, in which you may be interested, and which we send for ten cents. As to a current of electricity emerging from the earth's poles, an earth current around the earth from east to west would not produce such a current of electricity, but would produce lines of magnetic force which would emerge from the magnetic poles of the earth. These lines do not affect the human body in any way with sufficient force for us to perceive them. A person on the geographical pole of the earth is nearly 1,000 miles from the magnetic pole, and would not perceive any different sensations from what he would perceive on any other point of the earth. There is no outward force acting from the earth's poles; gravity is stronger there, and centrifugal force is zero there.

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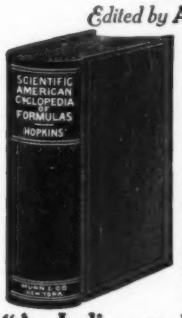

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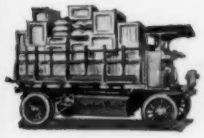

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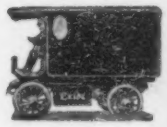

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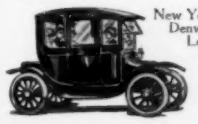

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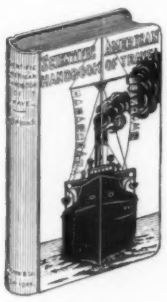

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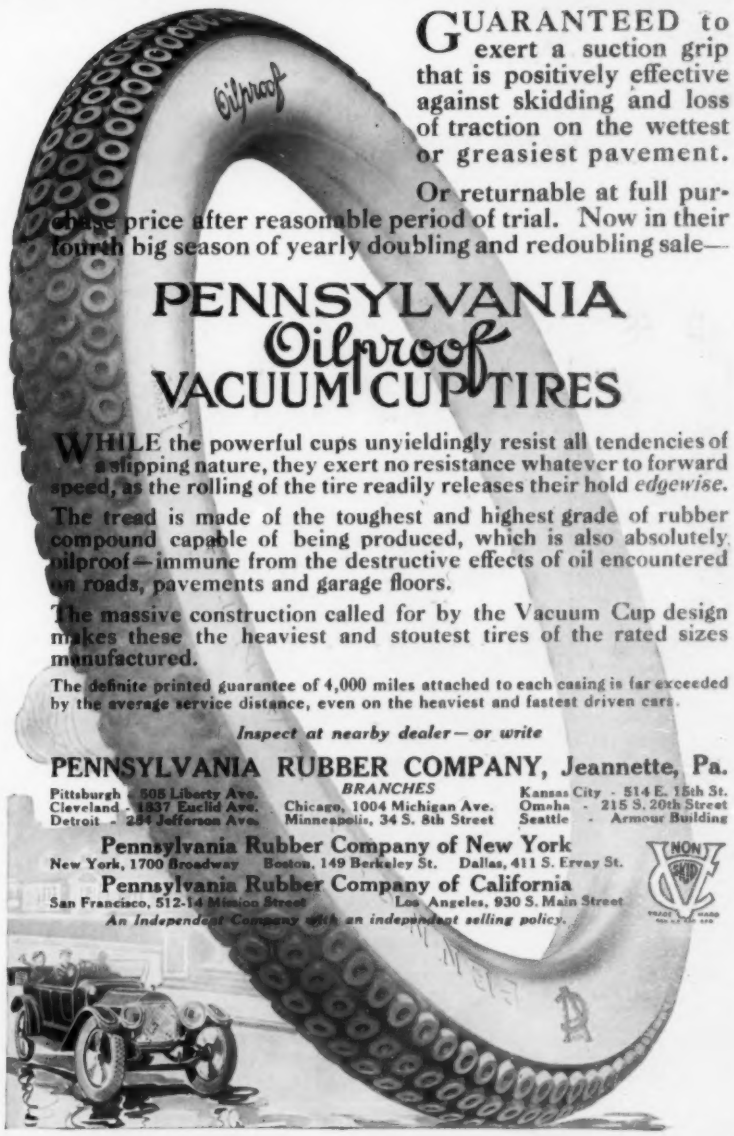

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